TESTS OF RIVETED JOINTS FOR BOILER-WORK.*

BY CHARLES HENRY MOBERLY, M. INST. C. E.

(*Concluded from page* 251.)

Whatever the amount of this strain, it is all credited to the section of the line of fracture, and hence the apparent increased strength of the plate in the joint and its ratio to the solid plate, given in the table. But by whatever amount the strain sustained by the half-rivet fell short of its full shearing strain, by that same amount was the total proper breaking strain of the specimen joint reduced; hence, the ratio of the strength of the joint also appears to be less than it really is. It seems, therefore, that the form of *E* gives as reliable results, in regard to the strength of the fractured plate and its ratio to the solid plate, as *A* and *B* did; but that the form *D* does not give reliable results.

Lastly, take *G* and *H*, which were again riveted in a similar manner. The plate in *H* was slightly stronger than the previous ones, but the ratio of its strength to that of the solid plate was nearly the same as in *E*. In short, *H* compares very well with *A*, *B* and *E*. In *G* the line of fracture passed inside both the half-rivets (Fig. 9), and the remarks made in reference to the right-hand half-rivet in *D* apply to both half-rivets in this joint; the more so as the left-hand one was nearly sheared. The effect would therefore be greater than in *D*. Accordingly, the strength of the plate in the joint and its ratio to the strength of the solid plate is still more increased than in *D*, while the ratio of strength of the joint is further diminished.

The conclusions drawn are:

1. When none of the rivets are sheared, and fracture takes place through all the rivet holes, the specimens, shaped through the centers of the rivets, give the most accurate result.

2. When rivets are sheared at the same time that fracture takes place, the specimens, shaped along a line between the rivets, give the most accurate result.

3. The correct way of estimating the strength of the joint is to compute it from the strength of the plate along the line of fracture, as obtained from the tests.

4. The best way of getting a direct result would be to have two sets of joints prepared, one set being one pitch wider than the other set. The difference between the mean breaking-strains of these two sets of joints would at once give the breaking-strain for one pitch, which is what is wanted.

II. The effect of the mode of forming the holes.

The holes were formed in four different ways, as already stated.

1. By punching with a punch $\frac{1}{16}$ in. in diameter, as in *A* and *B*.

2. By punching with a $\frac{1}{4}$-in. punch and drilling out to $\frac{1}{16}$ in. in diameter, as in *D* and *E*.

3. By punching with a $\frac{1}{4}$-in. punch and drilling out to $\frac{1}{8}$ in. in diameter, as in *G* and *H*.

4. By drilling $\frac{1}{16}$ in. in diameter out of the solid, as in *K* and *L*.

As the results obtained from *D* and *G* are not reliable, for reasons already stated, they are not used in the present comparison.

The mean results from *A* and *B*, and *K* and *L*, and also those from *E* and *H* separately, are shown in the following table:

Mark of joints.....	*A* and B	*E*	*H*	*K* and *L*
Breaking-strain of section in tons per square inch	23.25	23.79	24.42	25.53
Ratio of same to that of solid plate.....	0.776	0.793	0.798	0.846

It is unfortunate that only one specimen of each of the classes 2 and 3, with punched holes, drilled out, can be used; the more so as it seems rather anomalous that *H*, with the holes drilled only to $\frac{1}{8}$-inch in diameter, so as barely to remove the punched surface, gives a slightly better result than *E*, in which the holes were drilled out to $\frac{1}{16}$ inch in diameter, and the punched surface was well cleared out. No comparison can be instituted between *E* and *H*, but they are so nearly alike that they may be classed together, and the mean ratio of 0.795 may be taken for the strength of the plate in the joint, as compared with the solid plate in both cases.

Thus the ratio of the strength per square inch of the plate along the line of fracture, compared with the strength of the solid plate is:

1. For punched holes..... 0.776
2 & 3. " " holes punched small and drilled out..... 0.795
4. " " " drilled out of the solid..... 0.846

It appears that little is gained over the ordinary punching by punching the holes small and drilling them out larger; but by drilling the holes out of the solid the strength of the plate is increased 9 per cent., as compared with the punched holes.

* From Other Selected Papers of the Institution of Civil Engineers.

APPENDIX.

REPORTS NOS. 1 AND 6.—RESULTS OF EXPERIMENTS TO ASCERTAIN THE ULTIMATE TENSILE STRENGTH OF SIX RIVETED JOINTS RECEIVED FROM MESSRS EASTON & ANDERSON. ALL STEEL PLATES. NOMINAL THICKNESS, NINE-SIXTEENTHS OF AN INCH.

Sketch of Joint with Size.	A	D	G	B	E	H	C	P	Q	E	S	T
Test No. and thickness	P. 2,125 9-16 inch.	P. 2,134 9-16 inch.	P. 2,143 9-16 inch.	P. 2,128 9-16 inch.	P. 2,137 9-16 inch.	P. 2,146 9-16 inch.	P. 4,035 9-16 inch.	P. 4,038 9-16 inch.	P. 4,041 9-16 inch.	P. 4,044 9-16 inch.	P. 4,047 9-16 inch.	P. 4,050 9-16 inch.
Description of joint	Butt, double-riveted.	Butt, double-riveted.	Butt, double-riveted.	Butt, double-riveted.	Butt, double-riveted.	Butt, double-riveted.	Butt, double-riveted.	Butt, double-riveted.	Butt, double-riveted.	Butt, double-riveted.	Lap, single-riveted.	Lap, single-riveted.
Machine or hand-riveted	Machine.	Machine.	Machine.	Machine.	Machine.	Machine.	Machine.	Machine.	Machine.	Machine.	Machine.	Machine.
Rivet holes, per your description.	Punched 13-16.	Punched $\frac{15}{16}$ and drilled $\frac{15}{16}$.	Punched $\frac{15}{16}$ and drilled $\frac{15}{16}$.	Punched 13-16	Punched $\frac{15}{16}$ and drilled 13-16.	Punched $\frac{15}{16}$ and drilled $\frac{15}{16}$.	Plates drilled, covers punched 13-16.	Plates drilled, covers punched 13-16.	Punched $\frac{15}{16}$ and bored 13-16.	Punched $\frac{15}{16}$ and bored 13-16.	Punched 1.	Punched 1.
Plates, width and thickness.....	11.25 × 0.540	11.25 × 0.545	11.25 × 0.540	13.22 × 0.545	13.22 × 0.545	13.22 × 0.545	11.32 × 0.555	11.32 × 0.54	11.32 × 0.535	11.32 × 0.555	14.20 × 0.555	14.20 × 0.555
Plates, sectional area, gross.....	6.075 lbs. tons. 303,340 = 117.5	6.131 lbs. tons. 303,990 = 117.7	6.075 lbs. tons. 296,180 = 114.3	7.205 lbs. tons. 288,620 = 128.8	7.205 lbs. tons. 323,230 = 144.3	7.205 lbs. tons. 319,910 = 142.8	6.282 lbs. tons. 290,310 = 129.6	6.112 lbs. tons. 287,480 = 128.3	6.056 lbs. tons. 277,880 = 124.0	6.282 lbs. tons. 313,240 = 139.8	7.881 lbs. tons. 221,180 = 98.7	7.881 lbs. tons. 221,840 = 99.0
Stress, total.....												
Stress, per square inch of gross area, joint.....	43,548 = 19.3	43,009 = 19.1	42,169 = 18.8	40,058 = 17.9	44,861 = 20.0	44,491 = 19.8	47,046 = 21.2	47,035 = 21.0	45,885 = 20.5	49,863 = 22.5	28,330 = 12.6	28,404 = 12.7
Stress per square inch of plates, solid.....	67,537 = 30.2	67,380 = 30.1	66,105 = 30.8	66,747 = 29.7	67,260 = 30.0	68,612 = 30.6	66,197 = 29.6	63,257 = 28.2	63,562 = 28.3	69,587 = 31.1		
Ratio of joint to solid plate, percentage.....	64.19	63.83	61.02	60.02	66.70	64.71	72.0	74.3	72.2	71.6		
Where fractured..	Plate at rivet holes, silky.	Plate at rivet holes, silky. One rivet sheared.	Plate at rivet holes, silky and granular. Two rivets sheared.	Plate at rivet holes, silky.	Plate at rivet holes, silky. One rivet sheared.	Plate a trivet holes, silky and granular. Two rivets sheared.	Plate at 5 rivet holes and 1 rivet sheared, 100 per cent. silky. 73.15	Plate at 6 rivet holes, 100 per cent. silky. 71.90	Plate at 6 rivet holes, 100 per cent. silky.	Plate at 6 rivet holes, 100 per cent. silky.	Five rivets sheared	Five rivets sheared.
Rivets, diameter, area and number.	Steel 0.81 = 0.515 × 6 × 2	Steel 0.81 = 0.515 × 6 × 2	Steel 0.75 = 0.441 × 6 × 3	Steel 0.81=0.515 × 7 × 2	Steel 0.81 = 0.515 × 7 × 2	Steel 0.75 = 0.441 × 7 × 2	Steel 0.81 = 0.515 × 6 × 2	Steel 0.81 = 0.515 × 6 × 2	Steel 0.81 = 0.515 × 6 × 2	Steel 0.81 = 0.515 × 6 × 2	Steel 1.04 = 0.849 × 5 × 1	Steel 1.04 = 0.849 × 5 × 1
Rivets, sectional area, total square inches.....	6.180	6.180	5.292	7.210	7.210	6.176	6.180	6.180	6.180	6.180	4.245	4.245
Shearing stress per square inch of rivet area.....	42,611 = 19.0	42,008 = 19.0	48,408 = 21.6	40,031 = 17.9	44,831 = 20.0	51,799 = 23.1	48,432 = 21.7	46,517 = 20.7	44,964 = 20.1	50,686 = 22.6	52,159 = 23.2	52,259 = 23.2
Tensile strain per square inch of rivet area.....	64,362 = 28.7	64,362 = 28.7	64,362 = 28.7	64,362 = 28.7	64,362 = 28.7	64,362 = 28.7	78,505 = 35.1	78,505 = 35.1	78,505 = 35.1	78,505 = 35.1	63,395 = 28.3	63,395 = 28.3
Ratio of shearing to tensile, percentage.....	Rivets not sheared.	One rivet sheared.	Two rivets sheared.	Rivets not sheared.	One rivet sheared.	Two rivets sheared.	One rivet sheared.	Not sheared.	Not sheared.	Not sheared.	82.2 82.3	82.4

Tested as shaped by you as shown above.
(Signed) DAVID KIRKALDY,
99 Southwark Street, London, S. E.
23d Nov., 1881.

Re-shaped here to pitch of riveting as shown above.
Made for Messrs. Easton & Anderson, Erith Iron Works, Erith, Kent.
June 30, 1881.

III. The general arrangement or proportions of the joint.

For the purposes of this comparison, it is assumed that the fracture takes place along the zigzag line. The strength of the joints is then computed from the data of the experiments, as follows:

Multiply the net length of the line of fracture per pitch by the breaking strength per square inch of the metal in the joint, and by 100, and divide the product by the length of the pitch multiplied into the breaking strength per square inch of the solid plate; the quotient is the strength of the joint in a percentage of the strength of the solid plate.

Omitting *D* and *G* as unreliable, the following results are thus obtained:

	Strength of joint. Per cent.
Mean of *A* and *B*—holes punched 13-16 in.....	63.23
E, holes punched 5-8 in. and drilled out to 13-16 in...	67.12
H, " " " " " " ¾ in.....	76.18
Mean of *K* and *L*—holes drilled 13-16 in.....	71.67

These results are not quite the same as those previously obtained, because they are computed for a supposed uniform line of fracture, as stated. It will be seen that the drilled holes in *K* and *L* give an excess of strength of more than 13 per cent. over the punched holes in *A* and *B*, but do not give much excess of strength over the punched and drilled holes in *E* and *H*. The strength of the weakest of these joints was sufficient for the purpose in this particular case; but even the strongest of them was not satisfactory, as it should certainly be 75 per cent. of the solid plate. It is clear that the rivets were stronger than the plate, although calculation shows that when the diameter was reduced to ¾ inch, as in *G* and *H*, the shearing strength of the rivets was nearly the same as the tensile strength of the plate in the joint.

By increasing the pitch of the full sized rivets, the joint would be strengthened, but 3¼ inches pitch is quite wide enough for $\frac{9}{16}$-inch plates to insure tightness. If *D* and *E* be excepted, as the fracture in these two joints went past the rivet holes instead of through them, all the joints broke along the zigzag line, or from the rivet holes to the edge of the plate. This was probably due to the rows of rivets being too close together, as well as too near the edge, and also to the pressure used in riveting having been too great.

To settle this point it was determined to have four more joints tested, two with $\frac{13}{16}$-in. drilled holes (*O* and *P*), to be 75 per cent. of the strength of the solid plate, and two (*Q* and *R*) of the same proportions, but with holes punched ⅝ in. and drilled out to $\frac{13}{16}$ in. in diameter. All the joints were made from similar plates and rivets to those previously tried, but the accumulator-pressure was reduced to 25 tons. The pitch was 3.775 in. as before, and the breaking strength of the solid plate 30 tons per square inch. Then for 75 per cent. strength of joint the breaking-strain per pitch should be $3.775 \times 0.75 \times \frac{9}{16} \times 30 = 47.78$ tons. For a shearing strength of rivets = 24.5 tons per square inch, the area of each rivet $= \frac{47.78}{4 \times 24.5} = 0.49$ square in., so that $\frac{13}{16}$-in. diameter, giving a shearing area of 0.5185 square in., will do for the rivets.

As not one fracture occurred from hole to hole along the straight line, the strength of the plate is assumed to be sufficient in that direction. Taking the strength along the zigzag line to be 0.85 of that of the solid plate, the net length between the holes should be $\frac{3.775 \times 0.75}{0.85} = 3.33$ in., and this would be obtained by a distance between the rows of the centers of the rivets of 1.606 in. This distance was made 1½ in., so that the net length of zigzag line of fracture was 3.354 in. per pitch. The distance from the centre of the holes to the edge of the plate was increased from 1¼ in. to 1½ in.

This joint is shown in fig. 10, and the result of the tests given in Report No. 6, while the tensile tests of the rivets are stated in Report No. 7.

The calculated strength of the joint with $\frac{13}{16}$-in. drilled holes is $\frac{3.354 \times .85 \times 100}{3.775} = 75.52$ per cent. of the solid plate.

The tensile strength of the rivets in Report No. 7—varying from 31.45 to 38 tons per square in.—shows such irregularity, and is so much in excess of the former tests (the rivets being taken from the same lot), that it cannot be accepted as trustworthy. The shearing strength of the rivets will therefore be taken as before, at 24.6 tons per square in.

O broke with 133.6 tons, by shearing one rivet and breaking along a line of fracture = 7.8 in.; area of fracture = $7.8 \times 0.555 = 4.33$ square in. The strain that sheared one rivet was $24.6 \times 2 \times 0.515 = 25.34$ tons, leaving $133.6 - 25.34 = 108.26$ tons to break 4.33 square inches of plate; hence, strength of plate per square inch of fracture $= \frac{108.26}{4.33} = 25$ tons $= \frac{25}{29.6} = 0.845$ of solid plate.

The strength of this joint is given at 72 per cent. in Report No. 6; but, computing it in the manner already explained, the strength becomes $\frac{3.354}{3.775} \times 84.5 = 75$ per cent. If this joint had broken along the zigzag line throughout, like the next one *P*, the line of fracture for the pitch in which the rivet was sheared would have been 3.354 inches long, requiring a strain of $3.354 \times 0.555 \times 25 = 46.5$ tons to break it; whereas that pitch is here credited with a breaking strain for the plate of $1.6875 \times 0.555 \times 25 = 23.4$ tons, and for the rivet 25.34 tons, or a total strain = 48.74 tons.

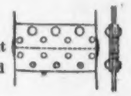
It is therefore fair to conclude that the rivet offered less resistance to shearing than has been assumed, and, consequently, that the strength of the plate along the line of fracture, as also the computed strength of the joint, was greater than given. But, considering the uncertainty of this conclusion, and the fact that the strength of the fellow-joint *P* is so much greater than that of *K* and *L* (which also had $\frac{13}{16}$-inch drilled holes), it seems preferable to adhere to the computed strength, and to use it, together with the results of joint *P*, for comparison with other joints.

P broke with 128.3 tons, by shearing through the rivet holes along a line of fracture = 9.46 inches; area of fracture = $9.46 \times 0.54 = 5.1$ square inches; strength of plate per square inch of fracture $= \frac{128.3}{5.1} = 25.15$ tons $= \frac{25.15}{28.2} = 0.89$ of solid plate.

The ratio of strength of joint given in Report No. 6 is 74.3 per cent. But, computed from the strength of the plate in the joint as explained, it becomes $\frac{3.354}{3.775} \times 89 = 79$ per cent., or more than was expected.

Q broke with 124 tons through the rivet holes, like P; length of fracture = 9.46 inches, area of fracture $= 9.46 \times 0.535 = 5.06$ square inches; strength of plate per square inch of fracture $= \frac{124}{24.5} = 24.5$ tons $= \frac{24.5}{28.3} = 0.866$ of solid plate.

REPORT No. 3.—RESULTS OF EXPERIMENTS TO ASCERTAIN THE ULTIMATE SHEARING STRENGTH OF THREE RIVETED JOINTS received from MESSRS. EASTON & ANDERSON. Steel Plates. Nominal thickness, nine-sixteenths of an inch.

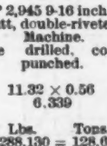
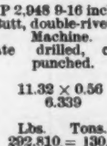
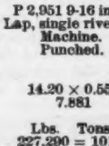
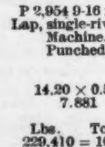
Rivets were drilled out / These Rivets Sheared  as requested by Mr. Moberly.

Test No.	Description.	Rivets. Diameter, area and number.	Sect. area.	Shearing stress. Total.	Per sq. in.
P.		Inch. Sq. in.	Sq. in.	Lbs. Tons.	Lbs. Tons.
2131	Punched-holes ⅞ C	Steel .81 = .515 × 3 × 2	3.090	164,880 = 73.6	53,359 = 23.8
2140	Punched ⅝, bored ⅞ F	Steel .81 = .515 × 3 × 2	3.090	167,810 = 74.9	54,307 = 24.2
2149	Punched ⅝, drilled ¾ (I)	Steel .75 = .441 × 3 × 2	2.646	152,790 = 68.2	57,774 = 25.77

Made for Messrs. Easton & Anderson, Erith Iron Works, Erith, Kent.

99 Southwark street, London, S. E., 6th September, 1881. (Signed), DAVID KIRKALDY.

REPORT No. 4.—RESULTS OF EXPERIMENTS TO ASCERTAIN THE ULTIMATE TENSILE STRENGTH OF FOUR RIVETED JOINTS RECEIVED FROM MESSRS. EASTON & ANDERSON. All steel plates. Nominal thickness, nine-sixteenths of an inch.

Sketch of Joint with Sizes.	K 	L 	M 	N 
Test No., and thickness	P 2,945 9-16 inch.	P 2,948 9-16 inch.	P 2,951 9-16 inch.	P 2,954 9-16 inch.
Description of joint	Butt, double-riveted.	Butt, double-riveted.	Lap, single riveted.	Lap, single-riveted.
Machine or hand-riveted	Machine.	Machine.	Machine.	Machine.
Rivet hold	Plate drilled, covers punched.	Plate drilled, covers punched.	Punched.	Punched.
Plates—Brand:				
Plates, width and thickness	11.32 × 0.56	11.32 × 0.56	14.20 × 0.555	14.20 × 0.555
Plates, sectional area, gross	6.339	6.339	7.881	7.881
	Lbs. Tons.	Lbs. Tons.	Lbs. Tons.	Lbs. Tons.
Stress total	288,130 = 128.6	292,810 = 130.7	227,290 = 101.4	229,410 = 102.4
Stress for square inch of gross area, joint	45,453 = 20.3	46,192 = 20.6	28,920 = 12.9	29,109 = 13.0
Stress per square inch of plates, solid	67,940 = 30.3	67,280 = 30.0	65,002 = 29.0	64,900 = 29.0
Ratio of joint to solid plate, percentage	66.9	68.6	44.5	44.8
	67.75		44.65	
Where fractured	Plates at five rivet holes, and one rivet sheared.	Plate at four rivet holes, and two rivets sheared.	Five rivets sheared.	Five rivets sheared.
Rivets: Diameter, area and number	Steel 0.81 = 0.515	Steel 0.81 = 0.515 ×	Steel 1.04 = 0.849 ×	Steel 1.04 = 0.849 ×
Rivets: Sectional area, total square inches	6 × 2	6 × 2	5 × 1	5 × 1
Shearing stress per square inch of rivet area	6.180	6.180	4.245	4.245
Tensile stress per square inch of rivet area	46,623 = 20.8	47,338 = 21.1	53,543 = 23.9	54,042 = 24.1
Ratio of shearing to tensile, percentage	Rivets were not sent for ascertaining the tensile strength and quality.			

Made for Messrs. Easton & Anderson, Erith Iron Works, Erith, Kent. (Signed) DAVID KIRKALDY, 99 Southwark street, London, S. E., Sept. 6, 1881.

The ratio of strength of joint in Report No. 6 is 73·2 per cent. But, computed from the strength of the plate in the joint, the ratio becomes $\frac{3.354}{3.775} \times 86{\cdot}6 = 76.9$ per cent.

R broke with 139.8 tons through the rivet holes, like *Q* and *P*; length of fracture = 9.46 inches; area of fracture = 9.46 × 0.555 = 5.25 square inches; strength of plate per square inch of fracture = $\frac{139.8}{5.25} = 26.63$ tons = $\frac{26.63}{31.1} = 0.856$ of solid plate.

The ratio of strength of joint in Report No. 6 is 71.6 per cent. But, computed from the strength of the plate in the joint, the ratio becomes $\frac{3.354}{3.775} \times 85.6 = 76$ per cent.

The following table gives the results for comparison of the means of *K* and *L* with *O* and *P*, and *E* with *Q* and *R*:

Marks of joints.....	*K* and *L*	*O* and *P*	*E*	*Q* and *R*
Ratio of strength of metal in joint to solid plate..	0.846	0.867	0.793	0.861
Computed ratio of strength of joint per cent	71.67	77.0	67.1	76.45

Thus the widening of the distance between th rows of rivets and between the rivets and the edge of the joint resulted in 7.57 per cent. increase of strength of the joint in the case of the drilled holes (*K L* and *O P*), and 13.9 per cent. in the case of the punched holes (*E* and *Q R*) drilled out; while the drilled holes in *O* and *P* show an advantage of only 0.85 per cent. over the punched and drilled holes in *Q* and *R*.

In every case the metal in the joint is weaker than in the solid plate; and this reduction of strength is least with the holes drilled out of the solid, and greatest with the punched holes. This result has very generally been obtained by most experimenters. Possibly the diminished pressure in the accumulator for riveting the four last joints *O, P, Q* and *R* may have contributed to reduce the weakening of the metal in the joint; but as the experiments do not supply any data for considering this point it cannot be noticed here, except to suggest that, if the pressure is too great for the diameter of rivet, thickness of plate and number of plates riveted, the metal round the holes may be injured and the strength of the joint weakened. This is a point that appears worthy of special investigation.

Whatever the true explanation may be of the diminution of strength of the metal in the joint, it is clear that the presence of the holes in the plate must somehow produce this result.

Supposing that the metal round the hole is not competent to bear the full strain due to its section, it may be assumed, without appreciable practical error, that a zone of metal round the hole does no work at all, and the rest of the section of the plate bears the full breaking strain of the solid plate.

Let d = diameter of the hole,
$d =$ " " inoperative zone of metal.
p = distance from center to center of the holes diagonally.
f = ratio of the strength of metal in the joint to the solid plate.

Then $(p - d) \times f = p - d_1$, and $d_1 = p - (p - d) \times f$.

For *K* and *L* $d_1 = 2.41 - 1.5975 \times 0.846 = 1.060$ and $d_1 - d = 0.2475$ in.
For *O* and *P* $d_1 = 2.49 - 1.6770 \times 0.867 = 1.036$ and $d_1 - d = 0.2235$ in.
For *E* $d_1 = 2.41 - 1.5975 \times 0.793 = 1.143$ and $d_1 - d = 0.3505$ in.
For *Q* and *R* $d_1 = 2.49 - 1.6770 \times 0.861 = 1.046$ and $d_1 - d = 0.2335$ in.
For *A* and *B* $d_1 = 2.41 - 1.5400 \times 0.776 = 1.215$ and $d_1 - d = 0.3450$ in.
For *H* $d_1 = 2.41 - 1.6600 \times 0.798 = 1.085$ and $d_1 - d = 0.3350$ in.

If this view is correct, the net effective section thus obtained should, for the joints tested, be greater along the straight line than along the zigzag line, as none of them broke along the straight line. The net effective length of plate per pitch is thus:

	Inches.		Inches.
For *K* and *L* along the straight line	2.715,	along zigzag	2.700
" *O* " *P* " " "	2.730,	" "	2.900
" *E* " " " "	2.632,	" "	2.534
" *Q* " *R* " " "	2.729,	" "	2.888
" *A* " *B* " " "	2.560,	" "	2.390
" *H* " " " "	2.690,	" "	2.650

At first sight these results do not bear out the supposition of an inoperative zone of metal round the hole, as in two cases, namely, *O* and *P* and *Q* and *R*, the zigzag length is greater than the straight one. But these joints were made with an increased distance between the rows of rivets; and it seems fair to infer that the metal along the zigzag line is weaker than that along the straight line. More experiments should be made to clear up these two points.

Meanwhile, as regards the proportions of the joints experimented on, with a pitch of 3.775 inches, the distance between the rows of rivets might probably be increased to 1¾ inch, with a slight addition of strength to the joint.

REPORT No. 5.—SUMMARY OF THE RESULTS OF EXPERIMENTS TO ASCERTAIN THE ELASTIC AND ULTIMATE TENSILE STRENGTH AND QUALITY OF THE STEEL IN FOUR RIVETED JOINTS RECEIVED FROM MESSRS. EASTON & ANDERSON.

PLATES—ALL CUT LENGTHWAY.

Specimens out of riveted joint.	Test number.	Thickness.	Stress. Elastic per square inch.	Stress. Ultimate per square inch.	Ratio of elastic to ultimate.	Contraction of area at fracture.	Stress per square inch of fractured area.	Extension-set in 10 inches. At 50,000 lbs. per square inch.	Extension-set in 10 inches. At 60,000 lbs. per square inch.	Extension-set in 10 inches. Ultimate.	Appearance of fracture.
	P.	Inch.	Lbs. Tons.	Lbs. Tons.	Per cent.	Per cent.	Lbs.	Per cent.	Per cent.	Per cent.	
P 2,945 K	2,946	0.57	35,700	68,405	52.1	44.5	123,389	3.71	7.61	26 6	Silky.
	2,947	0.55	35,500	67,475	52.6	45.7	124,326	3.55	8.40	26 8	"
	Mean.....		35,600 = 15.9	67,940 = 30.3	52.3	45.1	123,857	3.63	8.00	26.7	
P 2,946 L	2,949	0.57	35,600	68,140	52.2	41.0	115,595	3.52	7.39	25.5	"
	2,950	0.55	35,600	66,420	53.6	48.1	128,179	3.88	9.08	27.1	"
	Mean.....		35,600 = 15.9	67,280 = 30.0	52.9	44.5	121,887	3.70	8.23	26.2	
P 2,951 M	2,953	0.55	31,800	65,445	48.5	49.1	128,783	4.48	9.80	29.4	"
	2,952	0.56	31,800	64,560	49.2	47.4	122,762	4.46	11.10	29.6	"
	Mean.....		31,800 = 14.2	65,002 = 29.0	48.8	48.2	125,772	4.47	10.45	29.5	
P 2,954 N	2,956	0.55	32,600	65,110	50.0	34.3	99,198	4.03	9.20	26.5	"
	2,955	0.56	32,400	64,690	50.0	46.0	121,361	4 55	11 10	29.3	"
	Mean.....		32,500 = 14.5	64,900 = 29.0	50.0	40.4	110,279	4.29	10.15	27.9	
	Total mean....		33,875 = 15.1	66,280 = 29.6	51.0	44.5	120,448	4.02	9.21	27.6	

Made for Messrs. Easton & Anderson, Erith Iron Works, Erith, Kent.
Sept. 1, 1881.

(Signed) DAVID KIRKALDY,
99 Southwark Street, London, S. E.

REPORT No. 7.—SUMMARY OF THE RESULTS OF THE EXPERIMENTS TO ASCERTAIN THE ELASTIC AND ULTIMATE TENSILE STRENGTH AND QUALITY OF THE STEEL IN FOUR RIVETED JOINTS AND EIGHT RIVETS RECEIVED FROM MESSRS. EASTON AND ANDERSON.

PLATES—ALL CUT LENGTHWAY.

Specimens out of Riveted Joint.	Test No.	Thickness.	Stress. Elastic per square inch.	Stress. Ultimate per square inch.	Ratio of elastic to ultimate.	Contract of area at fracture.	Stress per square inch of fractured area.	Extension set in 10 inches. At 50,000 lbs. per sq. in.	Extension set in 10 inches. At 60,000 lbs. per sq. in.	Extension set in 10 inches. Ultimate.	Appearance of Fracture.
	P.	Inch.	Lbs. Tons.	Lbs. Tons.	Per cent.	Per cent.	Lbs.	Per cent	Per cent.	Per cent.	
P 4,035. O & P.....	4,036	.56	36,500	63,655	54.7	51.4	137,231	3.49	7.79	28.5	Silky.
	4,037	.55	35,600	65,740	54 1	53.5	141,514	4.11	9.37	29.8	
	Mean.....		36,050 = 16.1	66,197 = 29.6	54.4	52.4	139,372	3.80	8.58	29.1	
P 4,038. O & P.....	4,039	.54	33,700	63,310	53.2	52.0	131,998	5.35	12 8	28.6	
	4,040	.51	33,700	63,205	53.3	53.0	134,637	5.54	12.9	27.8	
	Mean.....		33,700 = 15.0	63,257 = 28.2	53.2	52 5	133,317	5.44	12.8	28.2	
P 4,041. Q & R.....	4,042	.52	33,800	63,710	53.0	52.5	134,397	4.66	11.1	31.2	Silky.
	4,043	.53	33,800	63,415	53.3	52.0	132,322	4.81	11.3	30.4	
	Mean.....		33,800 = 15.1	63,562 = 28.3	53.1	52.2	133,359	4.73	11.2	30.8	
P 4,044. Q & R.....	4,046	.55	39,200	69,720	56.2	52.9	148,054	2.08	5.61	27.5	
	4,045	.56	39,500	69,455	56.8	52.1	147,369	1.50	5.19	25.9	
	Mean.....		39,350 = 17.6	69,587 = 31.1	56.5	52.5	147,711	1.83	5.40	26.7	
	Total mean.		25,725 = 15.9	65,651 = 29.3	54.3	52.4	138,439	3.95	9.40	28.7	

STEEL RIVETS.

Nominal size of rivets.	Test No.	Original. Diameter.	Original. Area.	Stress. Elastic per square inch.	Stress. Ultimate per square inch.	Ratio of elastic to ultimate.	Fractured. Diameter.	Fractured. Area.	Fractured. Difference. Ar.	Fractured. Difference. Per ct.	Stress for square inch of fractured area.	Extension.	Appearance of fracture.
	P.	In. trd.	Sq. in.	Lbs. Tons.	Lbs. Tons	Per ct.	In.	Sq. in.			Lbs.		
¾ in. diameter.	4,055	.504	.200	47,300	85,130	55 5	.506	.102	.098	49.0	166,921	—	Top short for about one-third the length.
	4,053	.504	.200	47,100	84,810	55.5	.35	.096	.104	52.0	176,687	—	
	4,054	.504	.200	44,400	73,620	60.3	.32	.080	120	60.0	184,050	—	
	4,056	.504	.200	42,200	70,460	59 8	.30	071	.129	64 5	198,478	—	
	Mean			45.250 = 20.1	78,5 5 = 35.1	57 8				56.4	181,534		
1 in. diameter.	4,057	.714	400	34,700	65,740	52.7	.45	159	241	60 2	165,383	—	Silky.
	4,059	.714	400	34,000	64,110	53 9	.45	159	.241	60 2	161,283	—	
	4,060	.714	.400	34,2 0	62,330	54.8	.44	152	.248	62.0	164,626	—	
	4,058	.714	400	34,100	61,280	55.6	.44	152	248	62.0	161,263	—	
	Mean			34,400 = 15.3	63,365 = 28.2	54.2				61.1	162,989		

Made for Messrs. Easton & Anderson. Erith Iron Works, Erith, Kent.

(Signed) DAVID KIRKALDY, 99 Southwark street, London, Nov. 23, 1881.

The rates of strength are summarized in the following table :—

Description of Joints.		Ratio of strength of plate in joint to solid plate.	Ratio of strength of joint to solid plate.
			Per cent.
1¼ inch between rows of rivets, and 1⅛ inch from center of rivet to edge.	*A* and *B* with holes punched 13-16 inch in diameter	0.776	63.23
	E with holes punched ⅝ inch, and drilled out to 13-16 inch in diameter	0.793	67.12
	H with holes punched ⅝ inch, and drilled out to ¾ inch in diameter	0.798	70.18
	K and *L* with holes drilled 13-16 inch in diameter	0.846	71.67
1⅝ inch between rows of rivets, and 1¼ inch from center of rivet to edge.	*O* and *P* with holes drilled 13-16-inch in diameter	0.807	77.09
	Q and *R* with holes punched ⅝ inch and drilled out to 13-16-inch in diameter	0.861	76.45

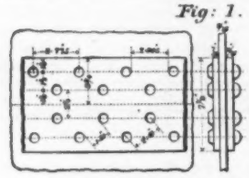
the rows of holes practically abolish this difference in strength? And, furthermore, would it increase the strength of the joint with punched holes so much as to make it little inferior to that with drilled holes? These are questions which require further experiments for their answer, and they appear to be well worthy of consideration. One point has still to be noticed in reference to these experiments, namely, the mode of attachment of the specimens to the machine. Figs. 4, 5, 6, 7 and 10, show how this was effected in each case. In joints *B, E, H, A, D, G*, ten 1-inch holes were used, namely, three in the first row, four in the second, and three in the third or back row. In all cases these holes were elongated by the test strain, the elongation being greatest in the first row, and rather less in each of the succeeding rows. It was also almost always greatest in the holes on or nearest the center line of the joint, diminishing to either side as the holes recede from the center line. The elongation of the front center hole varied from $\frac{1}{16}$ inch bare to $\frac{5}{16}$ inch full, while that of the holes in the back rows was only the difference between an easy and a tight fit of the callipers. Joints *K, L, O P, Q,* and *R,* were each held by twelve 1-inch pins, two more being put in the back row than before, with the effect of diminishing the elongation of the holes, so that it was hardly perceptible in the back row. But again the elongation appeared to be greatest at the center of each row of holes. Joints *C, F,* and *I,* in which the rivets were sheared, were attached by four 1¼-inch pins. The elongation of the holes was slight, rather more in the two middle holes than in the side ones. Thus in the joints *B, E, H, A, D, G,* with ten 1-inch holding pins disposed in three rows, where the greatest elongation occurred, the bearing pressure under breaking strain varied from from 20 to 26 tons per square inch. In the joints *K, L, O, P, Q, R,* with twelve 1-inch holding pins, disposed in three rows, when the elongation was less the bearing pressure was 18 to 21 tons per square inch. And in the joints *C, F, I,* with four 1¼-inch holding pins, all in one row, the bearing pressure was 20 tons per square inch, with hardly any elongation of the holes.

The last four tests of the series were with single-riveted lap joints, of the proportions of the circular seams in the boilers. The strength of the joint was evidently sufficient for the purpose, and it was not intended to test either this or the strength of the plate in the joint. The object of the tests was twofold—first, to ascertain the shearing-strength of 1-inch rivets, and secondly, to ascertain the effect on the same of the plates being curved transversely to the direction of the strain, which is the condition of these joints in boilers.

Two joints were made with the plates curved as in the boiler shell to a diameter of 10 ft. 3 in., and marked *M* and *N*, Fig. 11 ; and two others, exactly the same in all other respects, were left flat, and marked *S* and *T*, Fig. 12. The particulars of the tests of these joints are given in Reports Nos. 4 and 6, and those of the plates and rivets in Reports Nos. 5 and 7.

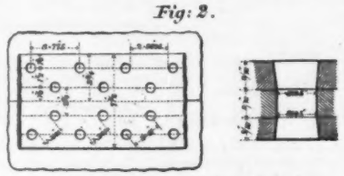
The diameter of the rivets was 1 in. nominal, the pitch 2.84 in., and the lap 3 in. nominal. The holes were punched and the joints riveted with an accumulator pressure of 35 tons.

Fig: 1.



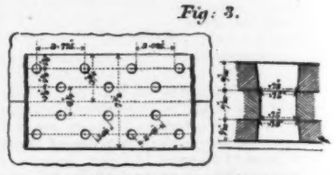
PARTICULARS OF JOINTS A.B & C.
Holes punched.

Fig: 2.



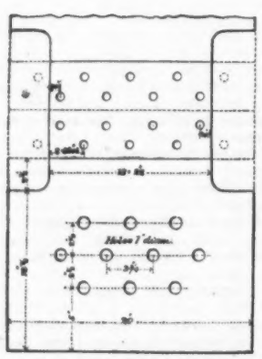
PARTICULARS OF JOINTS D.E & F.
Holes punched with ⅝ punch, and drilled out to ⅞ diam.

Fig: 3.



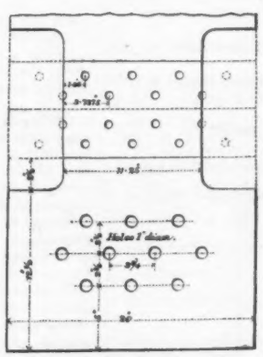
PARTICULARS OF JOINTS G.H & I.
Holes punched with ⅝ punch, and drilled out to ⅞ dia

Fig: 4.



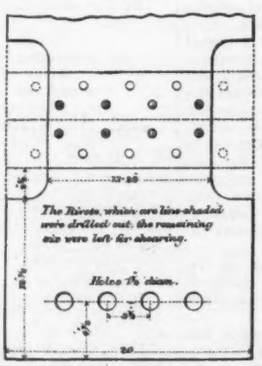
FORM OF JOINTS B.E.& H.

Fig: 5.



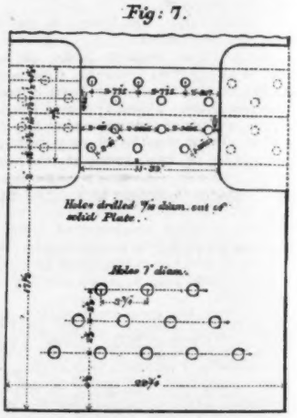
FORM OF JOINTS A.D.& G.

Fig: 6.



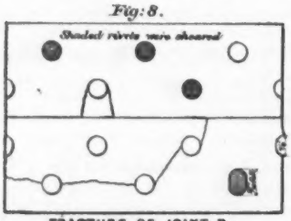
FORM OF JOINTS C.F.& I.

Fig: 7.



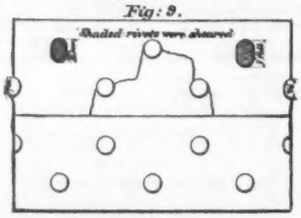
FORM AND PARTICULARS OF JOINTS K & L

Fig: 8.



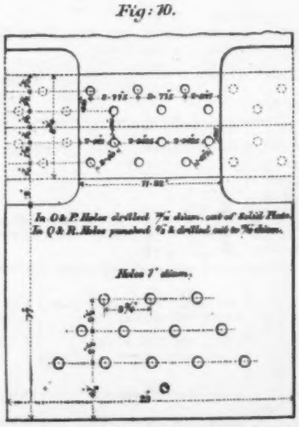
FRACTURE OF JOINT D.

Fig: 9.



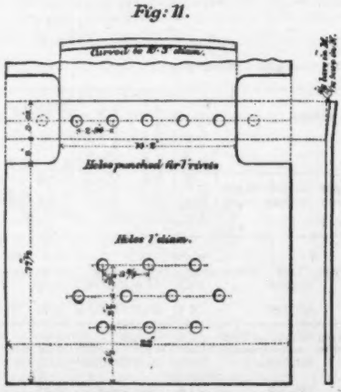
FRACTURE OF JOINT G.

Fig: 10.



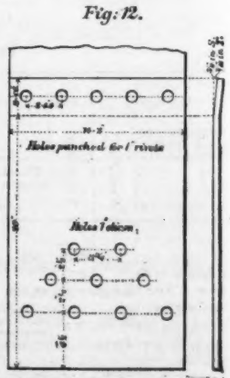
FORM AND PARTICULARS OF JOINTS O.P.Q.& R.

Fig: 11.



FORM AND PARTICULARS OF JOINTS M.& N.

Fig: 12.



FORM AND PARTICULARS OF JOINTS S & T

The obvious conclusion is that the punched holes make the weakest joint, and the drilled ones the strongest, while those with holes punched small and drilled out come between the two. Another conclusion is that widening the distance between the rows of rivets materially increased the strength of the joint. But there is yet a third conclusion of some importance, which appears to be justified by these results, namely, that increasing the distance between the rows of rivets reduces the difference in strength between the joints with drilled holes and those with holes punched small and drilled out.

Would a further increase of distance between

The results were as follows :

	Curved.		Flat.	
Mark of joints	*M*	*N*	*S*	*T*
Total breaking strains in tons	101.4	102.4	96.7	90.0
Shearing strain of rivets, tons per square inch	23.9	24.1	23.25	23.32
Mean tensile strength of rivets, tons per square inch	28.3	28.3	28.3	28.3
Ratio of shearing to tensile strains	0.843	0.852	0.822	0.824

In each case the plate was bent in the usual way, in the width of the lap, from the straight line, as shown in Figs. 11 and 12, namely, in *M* ⅞ inch bare, in *N* ⅞ inch bare, in *S* ⅞ inch, and in *T* ⅞ inch, or slightly more in the flat joints than in the curved ones. If the curved specimens had been wider, no doubt this bending back would have been less, while in a complete circle it would have been very much less. The mean shearing strength of the rivets was: in the curved joints = 24 tons per square inch = 0.848 of tensile strength; in the flat joints = 23.28 tons per square inch = 0.823 of tensile strength. The mean result with the ¾-inch rivets in double shear was 24.6 tons per square inch = 0.857 of tensile strength.

The conclusions drawn are as follows:

1. The curved lap-joint is stronger than the flat one, even in the comparatively narrow specimens tested. In a complete cylinder the excess of strength over a flat joint would probably be greater.

2. The 1-inch rivets are slightly weaker to resist shearing than the ¾-inch rivets; but probably this difference in strength would disappear on a complete circular joint, as the curved specimens give a greater strength than the flat ones.

3. Taking the tensile strength of rivets at 28 to 29 tons per square inch, it seems fair, for practical purposes, to assume the shearing strength to be 85 per cent. of the tensile strength for double-riveted, double-cover, butt-joints, and also for the complete circular lap-joints, and 82 per cent. of the tensile strength for flat lap-joints.

In conclusion, the attachment of the four last joints to the machine has now to be noticed, as shown in Figs. 11 and 12.

Joints *M* and *N* were attached by ten 1-inch pins, and placed between curved blocks to retain the plates in shape. The elongation of the holes was hardly perceptible.

Joints *S* and *T* were attached by nine 1-in. pins, but with two pins only in the front row, and the elongation (though still very slight) was greater than in joints *M* and *N*, while the elongation of the holes in the front row was perceptibly greater than in the back row.

The bearing pressure of the pins on the plate at the breaking strain was 18¼ tons per square inch of surface for joints *M* and *N* with ten pins, and 20 tons per square inch for *S* and *T* with nine pins.

The paper is accompanied by numerous diagrams, from which Plate 8 and the woodcuts in the Appendix have been prepared.

ENGINEERING SOCIETIES.

LIVERPOOL ENGINEERING SOCIETY.

The ninth meeting of the session was held on Wednesday, May 9, at the Royal Institution, Colquitt street. Mr. H. Brainall, president, in the chair, when a paper, entitled ', Crane Power for Dock Estates," was read by A. J. Maginnis, M. I. N. A. Commencing with some particulars which fully pointed out the great importance of this subject, the author proceeded to consider the various requirements for a serviceable crane power, and stated that it was remarkable that those who were accustomed to use crane power, as provided on dock quays generally, noticed that they were of such design and so placed as to comply more with the theoretical ideas of the designer than the wants of those for whom they were supplied,

After showing by a few facts the importance of punctual dispatch to sailing date, the serious risks and delays caused by the substitution of temporary sheer-legs, and untested gear were fully treated upon, and also the designs of cranes for special work from the users' point of view.

It was shown that for the work of putting in and taking out machinery from steamers nothing was better than the revolving crane, with great radial reach and height of jib, on a fixed site, such as those designed and manufactured by Sir William Armstrong, but the question of situation must be carefully considered, as unless placed so as to have clear water area in front of and on both sides of them, they may be rendered almost useless. For the more general purpose of replacing defective machinery, or working heavy lift cargoes, experience has proved the cranes on fixed sites to be obsolete, the modern system of floating cranes, which can be brought alongside the vessel requiring their services, having superseded them wherever yet tried. The utility and capability of these floating cranes were fully treated upon, and special circumstances related where the advantages were shown clearly. The disadvantages of them were also treated upon, but for the actual work required of them they were almost nil.

The new requirement of crane power for dry docks was next gone into and exhaustively dealt with, and here again the importance of ready and handy means for quickly effecting the repairs, which can only be done in dry docks, was pointed out, and also suggestions thrown out as to the design of the crane power which must in a short time be supplied. After showing that if proper advantage were only taken of the recent advances made in engineering (great improvement might be made in the existing disgraceful state of crane power, and serious delays avoided by ready permission to use the crane power being obtainable on the spot), the state of things existing when the happy millenium of crane power has been reached was next graphically described, and the importance of the use of the electric light on the incandescent system pointed out.

Before concluding attention was drawn to how far the port of Liverpool complied with the requirements of this important subject, and the writer pointed out that it was to be regretted that but little had been done toward achieving perfection by those whose talented energy and enterprise has produced a dock system second to none.

In conclusion it was asked if any suggestions had been put forward that present engineering resources could not fully conquer, and also pointed out that a matter which may be figuratively said to be the whole life and soul of the great steamship trade of to-day cannot be left in abeyance for the sake of its first cost, or because of the uncertainity of a step ahead of that yet effected in the design of crane power for dock estates. R. S. T.

May 11, 1883.

ENGINEERS' CLUB OF PHILADELPHIA.

ROOMS, No. 1523 CHESTNUT STREET.
PHILADELPHIA, PA.

Regular Meeting, Saturday Evening, June 2d 1883, at 8 o'clock.

Programme.

The Dikes of Holland (continuation).
Japanese Paper.
Electrical Formu'æ.

Record of Regular Meeting, May 19, 1883.

President Henry G. Morris in the chair; 20 members present.

Mr C. G. Darrach exhibited two profiles from Tiffin, Ohio, to Lake Station on the southern bend of Lake Michigan. The surveys were made for the Baltimore and Ohio short line to Chicago. One via Napoleon and the other via Defiance, Ohio.

The Defiance line (run by Mr. Darrach) was but 1¼ miles longer than an air line.

About 240 miles of surveys were run and the profile and maps plotted in 60 working days, with a party of eight men.

The Secretary presented a communication from Col. James Worrall with regard to the Panama Canal. Col. Worrall says:

"You may remember, in my paper on the Panama project, I alluded to a catch-water dam on the Chagres and compared it to the Schuylkill, endeavoring to convey an idea of its difficulty. By the inclosed slip from the New York *Times*, I see they have abandoned the idea of a dam. What next will they abandon? If they come to a quicksand they will abandon the whole thing, at least as a canal *a niveau*.

"They can get across that neck of land *with locks*, but it will be many a long day before they get a level trench dug through the Andes even at the Panama Gap."

Mr. T. M. Cleemann thought that the question of whether to build dams or a parallel cut had not yet been decided.

The Secretary presented, on behalf of Mr. A. R. Roberts, a handsome framed engraving with framed key-plate of "Conference of Engineers at the Menai Straits preparatory to Floating one of the Tubes of the Buttania Bridge."

HOWARD MURPHY, Secretary and Treasurer.

THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.

BY J. JAMES R. CROES, M. AM. SOC. C. E.

(*Continued from page* 247.)

DXXXV.—STOCKTON, CAL.

Stockton, California, in lat. 37° 55′ N., long. 121° 15′ W., is on level ground. There is no stream in its immediate vicinity.

Settled in 1848, it was incorporated a city in 1850. Water-works were built in 1857, as an individual enterprise by P. E. Connor, taking the supply from artesian wells. There are now 4 wells, one 145 ft., two 200 ft., and one 1,000 ft. deep. The water is pumped by three steam pumps, 1 No. 8 Blake, 1 No. 8 Cameron, and 1 No. 3 Hooker, into a stand pipe of plate iron, 3 ft. in diameter and 75 ft. high, and an iron tank 44 by 22 ft. and 8 ft. deep, at 50 ft. above the city. Distribution is by 10 miles of cast-iron pipe of 10 to 2 in. in diameter, with 10 gates and 600 taps. There are no fire hydrants. Service pipes are of wrought iron. The mains were originally of wood, which has been replaced by iron.

The population in 1880 was 10,282. The daily consumption is not given. The capital stock of the company now operating the works is $100,000. No further financial statements are given.

Byron Gallup is the Superintendent.

DXXXVI.—SANTA ROSA, CAL.

Santa Rosa, California, in lat. 38° 30′ N. long. 123° 40′ W., on Santa Rosa Creek, is in a valley 10 miles wide, between high mountains.

Settled in 1852, it was incorporated a city in 1867.

Water-works were built in 1873, by Preston Davis for a private company, taking the supply from Santa Rosa and Alamos creeks. A dam of concrete, 8 ft. thick and 100 ft. long, across the mouth of a cañon forms a reservoir of 20 acres area, at 80 ft. above, and 2 miles from the city, to which the water is conveyed by a pipe of No. 16 sheet-iron, 15 in. in diameter and reduced to 9 in. in the city.

Distribution is by 11 miles of wrought-iron pipe of from 5 to 1 in. diameter, with 23 fire hydrants, 40 gates and 485 taps. Service pipes are of wrought-iron. The city does not pay for hydrant service.

The population in 1880 was 3,616.

The daily consumption is not given.

The capital stock of the company is $250,000. The works have cost $108,500. The expenses in 1882 were $6,790 and the receipts $8,747.

Some spiral riveted wrought-iron pipe were used in the distribution, but with unsatisfactory results.

M. L. McDonald is the President and Treasurer, and James B. Rue the Superintendent.

DXXXVII.—ANNISTON, ALA.

Anniston, Alabama, in lat. 33° 40′ N., long. 85° 40′ W., on Snow's Creek, is on rolling land in a valley between mountains.

Settled in 1872, it was incorporated a town in 1879.

Water-works were built in 1881 by John W. Noble, for the Woodstock Iron Company, taking the supply from a well 10 ft. in diameter and 60 ft. deep. The casing of the well is of cast iron, made in segments, and settled as the well was sunk. The ground at the well is 50 ft. above the lowest part of the town. The water is pumped by a pump of 16 in. diameter and 48 in. stroke, operated by a Beam engine and built by Noble Brothers & Co., of Rome, Ga., into a plate iron tank 40 ft. in diameter and 40 ft. high on a stone foundation. Its top is 220 ft. above the well.

Distribution is by 2½ miles of cast-iron pipe of 10 to 4 in. diameter, with 30 fire hydrants, 10 gates and 12 taps. Service pipes are of wrought iron and lead.

The town is owned by the Woodstock Iron Co. and the works were built for the use of the iron furnaces, cotton mills, &c., and their operatives. The population in 1880 was 942. No record is kept of the consumption. The works cost $50,000. A. L. Tyler is President and Samuel Noble the Secretary and Treasurer.

(TO BE CONTINUED.)

The receipt of statistics as follows is acknowledge with thanks.

From James B. Rue, of Santa Rosa, Cal.
From B. Gallup, of Stockton, Cal.
From Louis M. Lein, of Anniston, Ala.

A STEEP RAILROAD.

Mr. George E. Mansfield is to build a railroad up the steep summit of Mount Kearsarge. The gentleman has been engaged in building several narrow-gauge two-foot railroads, first in Billerica Mass., and subsequently in the interior of Maine, between Farmington and Phillips, and in the shape of connections with the Portland & Ogdensburg road. It is one of these little two-foot wide roads that Mr. Mansfield proposes to build up Mount Kearsarge from North Conway.

The summit of that most picture-like peak of all New Hampshire mountains is 2,760 ft. above the level of North Conway, itself an elevated mountain town. And it is very steep and difficult to climb, on horseback or on foot, as many a summer tourist has ascertained. It is too steep, probably, at one part of the ascent, for railroading—even for cog-wheel railroading; and the projected road up Mount Kearsarge is to be like an ordinary traction railroad, except in two particulars; it will be but two feet wide, and will wind around and around the mountain, making a total journey of nearly fifteen miles, and a gradual rise in this spiral ascent. This rise, it is calculated by the projector, will be but 200 ft. to the mile; whereas the last two miles of the railroad from the Fabyan House up to "the base" of Mount Washington, where passengers get out and take the cog-wheel road, is a grade, if we are not mistaken, of 300 ft. to the mile; probably the steepest grade for any common traction railroad to be found anywhere, unless there is an exception in some part of General Meigs's stupendous road over the Andes. "Jacob's Ladder," that steepest part of the ascent of Mount Washington—up which the cog-wheel road, the original of that style of railroads, climbs so slowly—has a grade of about 1,900 ft. to the mile. Even for the cog-wheel system this is pretty tall climbing, and we doubt if there is any steeper spot on the line of its imitator, the cog-wheel road up the Righi Culm in Switzerland. This proposed ordinary traction road up a still steeper mountain (Kearsarge) would be impracticable in a straight ascent, even with cog-wheels.

ENGINEERING NEWS
AND
AMERICAN CONTRACT JOURNAL.

Tribune Building. New York City.

The Engineering News Publishing Company, Proprietor.

Published Every Saturday.

CONDUCTED BY

GEO. H. FROST and D. McN. STAUFFER.

TERMS OF SUBSCRIPTION:

$4.00.....PER YEAR TO U. S. AND CANADA.
$5.00 ..... " " " FOREIGN COUNTRIES.

Make all drafts and cheques payable to ENGINEERING NEWS PUBLISHING CO. Postal Money Orders, for convenience, may be made payable to GEO. H. FROST.

THE realistic novel of the day seems to be like the traditional French sapper—nothing is sacred for it; at the same time it might be imagined that civil engineering offered little room for the novelist's art. However, a novel, "principally intended for youth about entering the career of civil engineering," has been written by a M. Emile With, and it has been translated into Spanish by Don Juan Eloy de Bona.

FOR the kind appreciation of our "Bridge Number" of last week by special letters from subscribers and by large extra sales to parties wanting to send to friends abroad and at home we are very much obliged. Our data for the history and illustration of the bridge were obtained from most reliable official sources, and proof sheets were submitted before publication to the bridge engineers. We think, therefore, that while we have not added many "pictures" to the already large collection, we have given the most useful, accurate, comprehensible and condensed illustrated history of the East River Bridge yet published. We printed an extra edition, which is being sold off very rapidly, and which will be in further demand by European engineers.

THE NEW NIAGARA BRIDGE.

The location finally fixed upon for the site of the new Canada Southern Railroad Bridge over the Niagara River is a point about three hundred feet above the suspension railroad bridge; the span from bluff to bluff is 859 ft., and the track will be 245 ft. above the surface of water.

On April 11 the plans and proposals submitted by the Central Bridge Works, of Buffalo, were accepted, and the contract for the entire structure awarded them. The bridge is to be completed by Dec. 1, 1883.

The design selected by C. C. Schneider, the Chief Engineer, is what is known as a cantilever bridge; it will be a double-track steel bridge, built to carry on each track at the same time a freight train of maximum weight headed by two "consolidation" engines, with an allowance of 30 lbs. per square inch for wind pressure—equivalent to a velocity of 75 miles per hour; the safety factor is 5. The total length of the bridge will be 895 ft., divided into two cantilevers of 375 ft. on the Canadian and 395 ft. on the American side, supported on steel towers at the water's edge. A fixed span of 125 ft. is suspended from and connects the river arms of the cantilevers. The clear span across the river is 500 ft.

Work is already commenced on the foundations, which will be the solid rock; on the rock will be placed, under each pair of columns, a block of "béton coignet" 10 ft. thick, 20 ft. wide and 45 ft. long. The load supported by each pair of steel columns is 1,600 tons, so that the distributed load on the foundation will only be about $1\frac{11}{100}$ tons per square foot. The masonry will be carried to a height of 50 ft. above the water. On this will rest the steel towers 130 ft. high, and on these the steel superstructure.

Timber false works will be built from the bluff on either side to the edge of the water on a level with the top of the bluff, and upon these and the steel towers the shore arms of the cantilevers will be erected. The shore end will be firmly anchored to masonry capable of resisting an uplifting force of 400 tons; as this force, under the most unfavorable circumstances, can not exceed 200 tons, the safety factor is ample.

With the shore arms finished and anchored, the river arms will be built out, one panel of 25 ft. at a time, by means of a traveling derrick. The work being self-sustaining, of course no false-works are needed, nor would they be possible in this case. The last gap of 125 ft. between the ends of the cantilevers will be closed by a truss built upon and pushed out from the completed cantilevers. Expansion and contraction are compensated for at the junction of the ends of the cantilevers and the 125 ft. span.

ENGINEERS WHO WILL ATTEND.

The following members have to May 29 signified their intention of being present at the 15th Annual Convention of the Am. Soc. C. E., to be held at St. Paul, commencing June 19.

E. R. Andrews, J. B. Atkinson, J. Archbald, T. Appleton, W. H. Burr, C. Blackwell, A. Beardsley, E. S. Bowers, W. R. Belknap, J. D. Burr, H. R. Bradbury, W. L. Baker, C. P. E. Burgwyn, D. Bontecou, W. H. Bradley, E. C. Burns, C. L. Burdette, C. L. Crandall, W. B. Cogswell, M. Coryell, D. W. Cunningham, J. J. R. Croes, R. Cartwright, A. P. Clarke, E. A. Doane, M. M. Defrees, P. P. Dickinson, C. E. Emery, T. Egleston, M. T. Endicott, N. M. Edwards, F. N. Finney, F. U. Farquhar, R. Fletcher, J. P. Frizell, J. R. Freeman, C. G. Force, Clark Fisher C. E. Goad, F. Graff, J. M. Goodwin, D. M. Greene, C. E. Greene, Geo. S. Greene, Jr., T. L. Gillespie, C. L. Gates, J. P. Gould, E. L. B. Gardiner, W. A. Haven, W. P. Harris, F. B. Howard, J. H. Hanlon, W. M. Hughes, B. M. Harrod, C. Hermany, S. A. Harrison, W. S. Huntington, H. Harding, M. G. Howe, H. E. Horton, R. Hunt, L. M. Johnston, L. H. Knapp, John Kennedy, W. B. Knight, G. Lindenthal, D. J. Lucas, C. F. Loweth, John Lawler, D. E. McComb, R. E. McMath, Wm. Metcalf, C. E. Moore, H. G. Morris, T. H. McKenzie, G. W. McNulty, R. C. Morris, O. E. Michaelis, F. O. Norton, S. B. Opdyke, J. A. Ockerson, T. W. Putnam, A. B. Paine, F. C. Prindle, W. A. Pratt, E. Prince, G. H. Pegram, P. Roberts, Jr., T. R. Richards, R. L. Read, T. L. Randolph, H. B. Richardson, B. Rhodes, G. M. Rusling, C. Shaler Smith, W. H. Searles, R. Surtees, W. P. Shinn, D. McN. Stauffer, Wm. Sooy Smith, F. Slataper, R. A. Sharter, F. P. Stearns, H. E. Stevens, T. G. Sanderson, E. N. R. Talcott, E. Thatcher, A. L. Tulloch, W. H. Wiley, Jos. Wood, D. W. Wellman, G. Y. Wisner, H. R. Weeks, S. Whinery, J. W. Weston, Dr. F. M. Wolff, B. F. Morse, C. D. Ward, Jno. Bogart. About 65 ladies thus far are registered for attendance.

NOTES ON SUSPENSION BRIDGES.

A suspension bridge is said to have been built over a river in the province of Yunnan, China, 2,000 years ago. A later bridge of several hundred feet in length spanning the River Pei, supposed to have been constructed during the Ming dynasty, is made up of a number of chains anchored to the rock on either side, with other chains attached at various parts of the span and fastened to points on the shores above and below the roadway, to prevent swaying; the floor is of plank laid across these chains. Another Chinese bridge of 330 feet, similar to the above, is mentioned by Kirchen as having been built A. D. 65.

Bamboo suspension bridges exist in Japan. One over the Fujikaira River is about 100 feet above the river; its span is 60 feet; width 4 feet.

Humboldt refers to the rope bridges used by the South Americans; in one case examined by this distinguished German, the cables were almost 4 in. in diameter, made of the fibrous roots of the American agave. These cables were anchored to the trunks of trees on shore, and crossed transversely by bamboos tied to them. Humboldt says these bridges were subject to dangerous lateral swaying, and advises crossing them on a run. If the traveler and his guide walk at different rates of speed, and especially if the former stop and grasp the balustrade ropes, "the bridge will be thrown into convulsions."

In Hindostan, at Aligpore, is a suspension bridge with cables made of cane fastened by iron; the span is 130 ft., width, 5 ft.

Suspension bridges in Europe are mentioned by Scamozzis in his "Del Idea Archi," 1615. The principles of their construction were laid down by Bernouilli, who was born at Bâle, Switzerland, 1654, died 1705.

The first chain bridge in England appears to have been laid across the River Tees about 1741; it was a mere foot bridge 70 ft. span and two feet wide. In 1796 Finlay constructed a chain bridge in the United States, over Jacob's Creek, near Uniontown, Pa., taking out a patent for it in 1801. By 1811 eight bridges had been built on his plan, when they seemed to meet with disfavor, and their construction ceased. Finlay's bridge was made of iron links and iron suspenders, supporting a roadway; the towers were of wood.

In 1819 a bridge supported by cables was constructed across the Tweed at Berwick, England, by Sir Samuel Brown; it was 449 ft. span.

Telford's bridge over the Menai Strait was built in 1826. It was suspended by rods of iron, 5 in a set, connected by bolts and chain plates. The entire length of the chain is 1,710 ft., weight, 3,876,784 lbs.; cost, £211,791. The span between centers of towers is 579 ft. 10 in.; the roadway is 102 ft. above high water mark.

The Fribourg bridge in Switzerland was opened Aug. 23, 1834. Its span from pier to pier is 880 ft., and it is 167 ft. above the water. There are four wire cables, each containing 1,056 wires. It cost about $125,000.

The new bridge at Niagara Falls, designed for carriages and foot passengers, was built in 1868. Its span is 1,250 ft., the towers are 105 ft. high, height above the river 190 ft., roadway 10 ft. wide. There are two cables 7 in. in diameter.

The Wheeling Suspension Bridge over the Ohio river was 1,010 ft. span, built by Charles Ellet, Jr., in 1848, and blown down in 1854.

Arranged in the order of their length of span, some of the principal suspension bridges of the world would rate as follows:

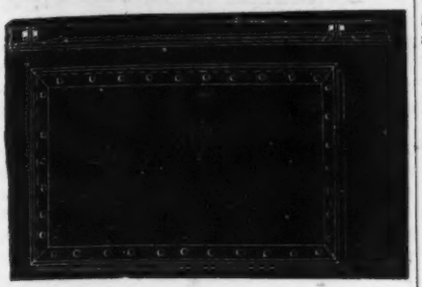
	Ft. span.	Built.
New York & Brooklyn	1,595½	1870-83
New Niagara	1,250	1878-80
Cincinnati, Ohio River	1,057	1866
Wheeling, Ohio River	1,010	1848
Fribourg, Switzerland	870	1834
Niagara, R. R. bridge	812	(?) 1848
Clifton, England	702	1864
Charing Cross, London	676¼	1845
Pesth, Hungary	666	1850
La Roche Bernard, France	650¼	1846
Nashville, Tenn	650	.....
Menai Straits, Wales	570	1826
Union, over Tweed, England	449	1820

THE HUDSON RIVER TUNNEL.

Since the late resumption of work upon the New York end an advance of 60 feet has been made. The work is now being done under a contract recently entered into between the Tunnel Co. and Mr. J. M. Wolbrect, C. E., late assistant engineer for the company. Mr. Wolbrect, in addition to his former connection with the identical work he has now contracted to perform, was for ten years an assistant to Gen. Gilmore on the Charleston Harbor improvements, and other important government work. Judging from the rapid increase in progress since he has had charge, he is putting his experience to very good use.

Ten feet of tunnel completed in 28 days was the best record before work was stopped; the same number of lineal feet is now built in ten days, and with seeming promise of regularity, though no one can foretell the morrow in work of this character. The most important change in method introduced by the present contractor is in the new form of plates. As at first used, the an-

gle irons were riveted flush with the four sides of the plate, and as a consequence, any wooden wedging or clay-tamping put between the flanges formed by the angles, was blown outward by the air pressure, when any shifting occurred in the line of the plate; if the plates were forced up slightly—a not infrequent occurrence—the joint opened outward and away went the packing. This circumstance, and the consequent loss of time in stopping the escape of the compressed air, was



one of the chief reasons for the former slow progress. As shown on the accompanying cut, the angle-iron is now riveted to the plate in such manner as to "break-joint," and any filling placed between the flanges is prevented from escaping outward by the projecting plate. The practical value of this slight modification, which in no way increases the cost of manufacturing the plates, is evident on inspection; the joints are readily "sealed" and seldom blow out, so that the time formerly spent on this class of work can now be expended in pushing forward the tunnel.

The rate of progress is at present fixed by the rather awkward arrangements connected with the supply shaft, and the maximum is about reached. The material removed from the heading must be handled about seven times before it is fairly outside. It is proposed to remedy this by extending the south tunnel sufficiently to allow a new shaft of ample size and improved design to be built.

The manager, Col. Haskins, is very sanguine as to the final success of the tunnel undertaking, and expects very shortly to resume work on the Hoboken side of the river.

THE SIMPLON TUNNEL.

The success of the St. Gothard line has been something extraordinary—the freight and passenger business have far exceeded calculations. This is not all—it has deflected trade to such an extent that the French are seriously alarmed, for they begin to see that the waves of commerce are like those of time—they are never backward cast. Freight and passengers that once went through France have now taken the Belgian and West German roads, and German goods are finding a market in Italy.

The only possible remedy for this condition of things is—according to both merchants and engineers—to find a shorter route than the St. Gothard, to pierce another mountain and make another tunnel. The Simplon presents some advantage over the St. Gotnard from even a commercial point of view—one of the proposed routes being 232 kilometres shorter than the Mount Cenis and 74 kilometres than the St. Gothard, calculating from Paris to Milan.

A paper by M. Meyer on the Simplon route was read at the last meeting of the French Civil Engineers. The following is a summary:

Preliminary studies were made in 1878 by M. M. Huber and Lommel. Lately, however, the *Compagnie de la Suisse Accidentale et Simplon* engaged M. Meyer to survey a new route. In the 1878 scheme the route left the thalweg of the valley of the Rhone, some six kilometres below Brigue, and rising along the hill side entered the tunnel over the town of Brigue at the altitude of 711 metres above the sea level. It passed under the highest points of Monte Leone, and entered the Diviera valley 1,100 metres up the river from Isolle.

The length of this tunnel would be 18,507 metres, but the objections urged against it are ones that have been since experienced in the St. Gothard. The principal one naturally arises from the high temperature, although we see that recent letters from the St. Gothard report a decided improvement in this respect. Under the highest tops of the Monte Leone at from 6,000 to 9,000 feet below the surface, the temperature would reach 110° F. in all probability, thus rendering the execution of the work an utter impossibility. The second difficulty arose from the neighboring dolomite and gypsum formations, which gave rise to so many accidents in the St. Gothard in the Andermatt valley. These same layers would pass under a tunnel that would be placed further north, and would consequently be harmless.

The interior temperature is not alone dependent on the size of the mountain mass, but is influenced in a far greater degree by the mineralogical composition, and the conductibility and stratification of the rocks. If the stratification is fan shaped, the refrigeration is far greater than when it is horizontal or vault shaped. By studying out the geological formation, M. Meyer fixed on first a point which would give the tunnel a length of 19,630 metres (somewhat over 12 miles). Here the temperature might be calculated at 9° C. less. Finally a point was found that would give a length of just 12 miles and a temperature of only 34° C.

The Arlberg system, in which the rails are permanently placed at the outset, and by which work may be carried on at several points, has been recommended. The Rhone could supply all the motive power in the northern part (from 4,000 to 8,000 horse-power), while the Diviera and the Chesasca would be utilized for Brandt drills. An average daily advance of 14½ ft. is supposed, which would give 6 years and 32 days as the time for completing a tunnel of 20,000 metres. The cost is estimated at 3,655 francs per running metre, or 73,100,000 francs for the 20 kilometres. The estimated cost for the Gothard was 4,000 francs per metre.

The ventilating system used in the St. Gothard would be replaced by having special compressors and pipes for that purpose alone. M. Meyer thinks that the proper ventilation of a tunnel is not in bringing in air at a high tension, but in having enough of it and reducing it frequently.

In addition to the cost of boring, the approaches on the south would cost from 29,500,000 francs to 33,500,000 francs, and those on the north from 2,280,000 francs to 2,450,000 francs.

A HIDDEN FACTOR FOR OVER-PRODUCTION.

To-day we are face to face in several of our industries with the panic prices of six and seven years ago. The immediate and apparent cause of all is over-production. In the iron trade production is in excess of requirements, prices have declined in some branches below cost, blast furnaces are shutting down as though a panic had unexpectedly broken in upon us, a general suspension in upward of one hundred rolling mills has been anticipated, which might continue all summer. Stocks of crude iron have accumulated unduly and consumers of iron and its products are standing in amazement at the sudden transition from booming activity and expanding prosperity to the gloomy one of inactivity, dulness and a relative industrial prostration. Of our seven hundred and fifteen blast furnaces there are less than three hundred in blast. Of a productive capacity nominally placed at 8,350,000 tons there is disemployed 33 per cent. Much of this nominal capacity, however, is useless, because of improvements in methods of making iron. Our rolling mill capacity is in a condition to be used to its full nominal capacity, and most of it has been profitably used during the past twelve months. But a turning point has been reached. There are more mills and more mill capacity than can be used. The remedy is to be found in an expansion of uses. Commercially there is an over-production—industrially considered there is not. The condition in which the iron trade finds itself is one of those to be anticipated when the causes and their bearings are considered. Prices in iron and in all else are declining. The increasing productiveness of capital invested is the bottom cause of the general downward tendency. That is to say, our capacity for the production of wealth is apparently greater than our capacity for consuming that wealth. Hence we must pause in our work of production from time to time until the periodic accumulations are absorbed, the shelves empty, the elevators and granaries depleted and the nations warehouses and storehouses emptied. But experience has shown these periodic depressions to be destructive of prosperity. The fault is deeper than can be reached by restriction. All deductions drawn from the over-production, theory lead to erroneous conclusions. Yet the iron trade is obliged to face the problem with its best means. These are restriction. The trade is familiar with them. They are looked for, and, as far as possible, discounted; but they produce strange results, run into strange extremes, the chief of which is the doubling of prices every few years and a corresponding feverishness to meet this increased demand.

The downward tendency in prices will probably prevent a portion of our present mill capacity from being used for some time to come. During the past four years old mills were from time to time re-established as demand expanded. The influences now culminating in a partial suspension will leave a number of badly equipped or situated mills idle, to wait for some future iron boom to call them into activity.

The surplus mill capacity, whatever it may be shown to be in the struggle for the survival of the fittest, will in all probability never be called again into activity.

Those and many others now on the safe side will be crowded out by improved methods of making iron and steel, with which metallurgical talent is now struggling with assured prospects of grand success. Iron making will be supplanted by machine methods for steel making at greatly reduced cost. The evidence of this is too abundant to call for specification. If we are vexed with over-production to-day, we will be overwhelmed with it ten years hence, for so far as that outward phase of the question is concerned, the evil will grow and expand year by year, through the necessities of the people for more material, the increase of actual wealth and the increased effectiveness and productiveness of improved mechanical appliances and metallurgical processes.

The prime factor underlying all activity, all prosperity, all advancement, is our agricultural capacity; all else is but assistance when reduced to elements.

The railway system is a result of land occupancy and a cause of it. Our cereal producing capacity has been expanded many fold by the railway system, and the expansion is progressing. Herein comes the compensating benefits; more producing acres, more cotton, more wealth from Mother Earth will arrest the evils which are cropping out in our industrial system and known erroneously as "over-production." The two great factors of industrial and agricultural development will balance and equalize each other, will mutually support and supplement each other, will harmonize and stimulate, will repress antagonisms which grow from maladjustment.

Manufacturers, merchants, men who have no time to look behind things and to investigate the underlying causes, are accustomed to take glancing views of current tendencies and to wonder whither we are drifting. There is no special cause for unrest. The occupancy of the land, the greater utilization of our vast agricultural capacity will year by year evolve a true industrial and commercial harmony out of apparently unassimilating elements. We cannot arrest the creation of wealth of our world. We cannot stay God's sunshine and rain, nor chain energy and labor, nor arrest the inventive talent which is hewing out new pathways in the untrodden future of human progress.

ONE WEEK OF THE EAST RIVER BRIDGE.

May 24—Opened. Public traffic commenced at 11:20 p. m. The first cent on the New York side was paid by a newspaper reporter; at the Brooklyn end John Rice and Geo. S. Oliver got through at the same time. Chas. C. Overton, of Coney Island, succeeded, after two hours of waiting, in driving the first vehicle over the bridge, both ways; as the New York gate was not opened by the time he arrived at it from Brooklyn, he turned and drove back. At 12:20 a. m., on the 25th ult., Secretary of the Navy William E. Chandler, Postmaster-General Gresham, ex-Congressman A. M. Bliss, and Mr. W. C. Kingsley drove up to the *Sun* office in an open barouche. Mr. Bliss alighted and sought an interview with a reporter. Secretary Chandler said: "We thought the *Sun* would like to know the names of the first carriage-party to cross the bridge. Some market wagons went over before us, but they do not count. Good morning."

May 25—At noon the official count announced that 19,500 people had paid the one cent fare at the New York gate. The total receipts at midnight were $2,001.21 collected in tolls, of which $597.23 was from teams, showing that the number of foot passengers who paid during the first twenty-four hours was 140,398.

May 26—The tolls collected amounted to $1,507.28, of which $520.16 was from teams.

May 27—From foot-passengers $1,635.84 and for vehicles $418.50. The crush was so great that the toll-takers could not make change fast enough, and to prevent blockades, fully 50,000 people were allowed to pass through without paying. Mr. Walter N. DeGrauw, the managing director of the Union Ferry Company, said his receipts were $120 more last Sunday than the previous Sunday. That was accounted for by people walking across the bridge and taking the boat back. If the bridge were made free for vehicles as well as pedestrians, the ferries would be ruined. The company would stop business when its leases expired, dispose of its property, and leave New York to provide ferry accommodations as required under the old English charter.

May 28.—There were 77,296 foot passengers.

May 29—There were 50,646 foot passengers.

May 30.—Between 8 a. m. and 4 p. m. on Wednesday there were 36,200 passengers admitted to the promenade, and from 4 p. m. to midnight there were 27,480 passengers.

The grand parade of Decoration Day was over, the regiments of volunteers and the crowds of spectators had returned to their places of meeting, had gone to the cemeteries, to their homes, on some of the numerous excursions of the day, or strolled along the streets and to the great new promenade that joined the sister cities. The bridge is still a curiosity, and only on holidays can the masses of the people visit it. So it naturally happened that the narrow footway which constitutes the finest promenade on this or possibly any other continent was well patronized during the entire day. At about 4 p. m. a blockade occurred a short distance from the flight of steps on the New York anchorage. It is described as follows by one of the daily newspapers:

These steps are over the point where the cables emerge from the anchorage. Between them and the New York tower the cables come above the footpath floor and narrow pathway about nine feet. The steps are fourteen feet broad, and in two flights of seven steps each, broken by a landing eight feet across. The treads of the steps are a foot broad, and the total rise of the two flights of steps is about nine feet. This first jam formed in the narrowed pathway beyond the steps. Bridge Policeman Frederick Richards broke it up and started the line moving again. The crowd from Brooklyn met the crowd from New York, and jammed again at the foot of the stairs. The Brooklyn crowd completely covered the footpath above the steps, and the New York crowd covered it below the steps. The former attempted to push down and the latter to push up. Those behind pressed forward, and the weakest—the women and children—were thrust against the iron railing of the steps and against the iron trestle work which surrounds the railroad track, and which begins at the head of the steps. They screamed with pain and terror.

Somebody shouted out that there was danger, and the impression prevailed that the bridge was giving way beneath the crowd. At that the crowd on the board walk above the steps pressed on toward New York more furiously, while those below who were on the asphalt knew they were in no danger, and did not move. A woman held her baby over the trestle-work and begged some one to take it. Men climbed out on the trestle-work and down to the railroad tracks outside. The bridge men who were stationed alongside the south roadway procured planks and laid them from the railroad bed to the footpath below the stairs. They did this on both sides of the footpath, and removed the section of iron fence that was nearest the steps. They pulled out women from the jam, and helped people down the planks.

This gave the Brooklyn crowd a chance to move, and it surged ahead for a few feet. Bridge officers ran along on the stringpiece of the trestle work and turned back toward Brooklyn those who were on the south side of the path. But as soon as the officers had passed by these people faced round again. Nobody among them or among the thousands pressing on them from behind suspected the tragedy that was coming. A half dozen rough-looking young men bunched themselves together some three hundred feet above the stairs. They laid their hands on each other's shoulders and forced themselves like a wedge into the crowd ahead. They shouted out: "The——Association can make its way through anything."

THRUST DOWN THE STEPS.

Either their pushing, or the general pushing toward New York, thrust the crowd ahead too rapidly. They were pushed in spite of themselves toward the steps. They seemed to have a horror of going over the steps, although the flight is only five or six feet high. They locked arms, and pushed furiously back against the thousands coming steadily over from Brooklyn. In a few minutes, at the point just above the steps, there was a slow yielding to the frightful pressure from behind and the front of the crowd was forced nearer and nearer to the edge. Women and children were screaming for help, and men were shouting confused. Umbrellas, parcels and canes were thrown over the rails at the side by people who needed their hands to fight their way out of the desperate crush.

At last, with a single shriek that cut through the clamor of the thousands of voices, a young girl lost her footing, and fell down the lower flight of steps. She lay for a moment, and then raised herself on her hands, and would have got up. But in another moment she was buried under the bodies of others who fell over the steps after her. She was dead when they got her out more than half an hour afterward. Men sprang upon the rails at the side and waved the crowds back from both the New York and Brooklyn sides. But the people continued to crowd on toward the steps. No police were in sight. Men in the crowd lifted their children above their heads to save them from the crush. People were still paying their pennies at both gates and swarming in.

The two extemporized side exits by way of planks to the railway were insufficient to relieve the crush, and the result was that all those who fell could not be reached. The people advancing from Brooklyn continued to fall over those in front until they were piled in a struggling, suffocating mass at the foot of the lower stairs and on the landing between the flights. Bridge officers attempted to reach them, but were kept back by the still advancing throng. Policeman Beglan forced his way to the head of the stairs and threatened and clubbed till he forced a way through and turned many back.

Twelve people were killed outright; how many more will die from their injuries will probably never be known; how many will carry through life the effects of the jam and the fright will never be known. It is a most lamentable affair and gives a sad tinge to the opening history of the great structure on which the accident occurred.

Thus the first week of the great bridge closes. Opened amid unequaled public rejoicings, by the Chief Magistrate of the nation; tested for six days by an unparalleled traffic of all kinds and with the most gratifying results as to stability—it closed amid a scene of extraordinary suffering and death.

So far as it is at present possible to judge of the causes of the accident, it was the result of stupidity and brutal selfishness on the part of a number of the people who created the panic. New York swarms with brutal men. As children they were little savages, roaming parks and streets, always intent on molesting other children, damaging property or making themselves nuisances wherever they appeared for even a few minutes. As hoodlums they grew to manhood, and as men they know of nothing but violence and total disregard of the rights of others. A jam on the sidewalk, in a building, in any place, is rather a pleasant episode for this class, and the death of a few women and little children, and the maiming of scores of others, is something very delightful to remember. There was no occasion for the bridge jam on Wednesday afternoon if the most ordinary courtesies of daily city life had been observed. But a few selfish people would go to the left when they ought to have kept to the right, and in total disregard of the orders of the police and those who sought to break the blockade. Men crowded in like beasts of prey, and precipitated the catastrophe.

As showing what ordinary intelligence will do in such a case, we note an incident of the great Chicago fire. On the night of Oct. 9, 1871, while the fire was leaping wildly across the river and enveloping the great warehouses and business buildings of the South Side in its destroying embrace, a stream of terror-stricken people, men, women and boys, pushed through the Washington street tunnel under the Chicago River from the South to the West Side. Another long column of eager sight-seers from the West to the South Side took the same tunnel route, the bridges being burned away. The footway of the tunnel is about 10 ft. wide and it has no partition to divide the meeting columns of passengers. It was packed full on that terrible night, when the South Side gas works exploded, and almost immediately the tunnel was in darkness. Here was the occasion for a panic and a jam which would fill the tunnel with dead and maimed people and a city with mourning. But a few sensible men with presence of mind called out, "to the right!" "to the right!" and the invisible processions, taking up the cry, passed it along, with the result that very soon the tunnel was cleared without injury to a single person. And yet the incident was surrounded with everything to excite the mind. On the bridge, on Wednesday, everything was as placid as the day was beautiful, and there is no use in declaiming about negligence of bridge engineers and trustees to take proper precautions for the protection of the public. There is a portion of the public that will not be protected, and all the police and guard-rails that could be set up will not restrain them. Only such fearful lessons as that of Wednesday can beat a perception of the dangers incident to such an apparently ordinary occurrence as crossing a bridge into the sodden brains of this class. The only pity is that others, and not they, are the principal sufferers from their selfishness.

Mr. Martin, the Superintendent of the East River Bridge, has probably had more things to look after in the past week than five men could possibly attend to. For months previous to its opening the bridge swarmed with workmen, and everything was pushed forward most energetically by Engineers, Trustees, and Brooklyn's enterprising young Mayor. The paint was still wet on the opening-day; the entrances unfinished; the cable railway will take another month to set in operation; the electric lights are as yet imperfect; the police and toll-taking force is unorganized and untrained; there is no immediate signal service between the termini, and, in fact, the great bridge is not finished. All these details have to be cared for by the Superintendent, at the same time that an unusual traffic is being thrown on the bridge for instant and constant supervision and protection. It will take time to bring systematic order out of this partial chaos, and Supt. Martin will probably do it as quickly and as well as any other man could under similar circumstances.

OBITUARY.

Major GEORGE W. DRESSER, Member of the American Society of Civil Engineers, and editor of the *American Gas Light Journal*, died at Newport, R. I., on Monday the 28th ult., aged 45 years.

Major DRESSER was a native of Connecticut, and was appointed to a cadetship in the Military Academy at West Point from Massachusetts in July, 1856. He was commissioned Second Lieutenant of the Fourth United States Artillery May 6, 1861. During the ensuing two months he was engaged in drilling the "raw recruits" in Washington. He entered the Manassas campaign as First Lieutenant. He was engaged in the Battle of Bull Run and in the defense of Washington. He entered upon the Virginia Peninsular campaign in March, 1862, and was assigned to engineer duty at the siege of Yorktown. For two months he was Acting Ordinance Officer of the Third Army Corps. From September, 1862, until August, 1863, he was Assistant Instructor of Artillery Tactics at West Point. During the remainder of that year he was assigned to engineer duty and the command of his company, the Fourth Regiment of Artillery, at Chattanooga, Tenn. He was appointed inspector of the Fifth Army Corps in July, 1864, and held the position until March, 1865, and during the ensuing four months was on detached service with Gen. W. F. ("Baldy") Smith in New Orleans and in this city. He was breveted captain in August, 1864, for gallant services during the operations on the Weldon (Va.) Railroad, and major in March, 1865, for good conduct and gallant services during the rebellion. He resigned Oct. 13, 1865, and entered upon the practice of his profession as a civil engineer. He was engaged in the survey of Block Island Breakwater and the defenses of Narragan-

sett Bay in 1866-8, and was subsequently resident engineer of the Harlem River & Port Chester Railroad, chief engineer of the Wickford Branch Railroad, and assistant engineer in the Department of Public Works in this city. He had also been secretary of the Society of Gas Lighting, and was an honorary member of the British Association of Gas Managers. In October, 1875, Major DRESSER became the editor of the *American Gas Light Journal*, which position he retained until his death. He visited Europe in 1878 to investigate the probabilities of electric lighting. He was a very enthusiastic member of the American Society of Civil Engineers, and took an active interest in the discussions of papers, and also in its annual conventions. Major DRESSER married the daughter of Daniel LeRoy, a well-known wealthy resident of this city. Mrs. Dresser died in this city about two months ago. On the day of the funeral of his wife Major DRESSER was compelled to seek medical attendance. His funeral took place in Newport on Decoration Day, where the interment of the body of Mrs. Dresser took place at the same time. The city of Newport was represented by Mayor Franklin. The army and navy and the Engineer Corps were also represented, as was the local population and the summer residents, many of whom came expressly to attend the obsequies. Many laboring men who worked for the deceased at Fort Adams were present. The bearers were Major Throckmorton, Capt. Morris, Capt. C. C. Churchill, Mr. A. Smith, Superintendent, and Mr. V. Smith, Engineer of the Manhattan (New York) Gas Works; Mr. Greenough, Engineer of the Boston Gas Light Company; Capt. F. A. Judson, Mr. Edward A. Crocker, Mr. W. D. King and Mr. H. A. Bentley. Elegant floral tributes almost hid the coffin from view.

PERSONAL.

Mr. ALVARO ADSIT, Superintendent of the Burlington (Vt.) Water-Works, has resigned.

The Secretary of the Canadian Pacific has been appointed chief engineer of the same road.

Mr. DE WITT C. CREIGER has been appointed Commissioner of Public Works for Chicago.

THE PRESIDENT of the Toledo, Cincinnati & St. Louis road is familiarly known as the "little bantam of the West."

Mrs. WASHINGTON A. ROEBLING, of Brooklyn Bridge fame, will attend the convention of the American Society of Civil Engineers at St. Paul.

T. W. SPENCER, engineer of the Rochester Division of the West Shore road, has been appointed Chief Engineer of the State Railroad Commissioners.

CHARLES BURLEIGH, inventor of the Burleigh rock drill, died at his residence in Fitchburg (Mass.), May 28, He was 58 years of age, and leaves a widow and three sons.

W. D. WALDON, superintendent of bridge building, Chicago & North Western Railroad, at Clinton, Iowa, D. C. DUNLAP of the engineering corps, and their clerks have been removed to Clinton, Iowa.

HERBERT HACKNEY, a Cornell graduate of 1876, is reckoned the most successful alumnus of that institution. He began at Milwaukee at $1,200 a year, has since been engaged at Youngstown, Ill., at a salary of $4,000, later at Chicago at $9,000, and has recently signed an agreement to go to Portland, Or., where he is to remain three years, and will receive the sum of $12,000 per year for his services as an engineer.

Mr. E. S. CHESBROUGH, of the Department of Public Works, N. Y., returned from Europe by the *Adriatic* on Friday of last week, after an absence of seven months, during which time he was in England, France, Switzerland, Italy and Spain engaged in special professional investigations. Mr. CHESBROUGH was very ill for some weeks in Madrid, Spain, and has not yet recovered his usual health.

Prof. J. E. MCGRATH, of St. Louis, Mo., was lately at San Bernard (Texas). He is engaged on the United States coast and Geodetic survey. The engineering corps are at Matagorda, Tex., and are likely to remain there during the summer. They are engaged in connecting the surveys made in 1853 and 1855. They first ran a base line along Matagorda peninsula. Professor MCGRATH is hunting the old points established by these two old surveys.

VANDERBILT UNIVERSITY DEGREES—NASHVILLE, May 30.—The degree of L.L. D. was conferred upon Prof. MILTON W. HUMPHREYS to-day by Vanderbilt University. This is the first honorary degree conferred by this institution. At the eighth annual commencement of the university to-day eight degrees of Bachelor of Arts, three of Bachelor of Engineering, six of Bachelor of Science, one of Bachelor of Sacred Theology, one of Civil Engineer and fourteen of Bachelor of Law were conferred.

Prof. CHANNING WHITTIER has resigned the chair of mechanical engineering in the Boston institute of technology, and the work is to be done next year by Prof. LANZA. These appointments have been made: W. O. CROSBY, assistant professor of mineralogy and lithology; GEORGE F. SWAIN, assistant professor of civil engineering-WEBSTER WELLS, assistant professor of mathematics; LEWIS M. MORTON, assistant professor of organic chemistry; PETER SCHWAB, '78, instructor in mechanical engineering.

A FEW RICH ENGINEERS.—The FINK brothers are all connected with railroad interests. There are three brothers—ALBERT, HENRY and RUDOLPH. They are Germans and engineers, and their combined salaries exceed those paid to any family in the United States. These three brothers get about $100,000 a year. ALBERT FINK has built some of the most important railroad lines in the South. HENRY FINK is with one of the largest Southern systems. RUDOLPH FINK is building the main line of railroad into Mexico for the Boston men.

TROY, May 28.—FREDERICK A. CROWLEY, a young civil engineer of this city, son of PATRICK CROWLEY, proprietor of the Mansion House, committed suicide in the bathroom of his father's private residence on Second street this afternoon by cutting his throat with a razor, severing the jugular veins, carotid arteries, and wind pipe. Young CROWLEY had been in ill health for a long time, the result of over study. He had recently been employed on the Thames River (Conn.) improvements, and was a young man of promise.

Speaking of the prominent positions occupied by Western men in Eastern business circles, the New York *Tribune* says: "A notable example to be seen almost daily on Broadway when he is not being feted abroad, as now, is NORVIN GREEN, the President of the Western Union Telegraph Company. It is not so many years ago since he rode through Kentucky as a country doctor, carrying his medicine in his saddle-bags behind him. Singularly enough, quite recently, DR. GREEN had opportunity to remind ex-Secretary BLAINE that, thus accoutred and employed, he used to encounter him when a schoolmaster in the same backwoods.

Gen. HART L. STEWART died last week at his residence 1635 Prairie Avenue Chicago, aged 80 years. Gen. STEWART was born in Bridgewater, N. Y., Aug. 29, 1803. His early life was spent at home, and from the time he was 12 years of age until he was 18 he assisted his father in clearing a large acreage of timber land in Genesee County, New York, which he had purchased from the Holland Land Company. Upon attaining the age of 17, however, he began the study of law, but his father being unable to support him, he was compelled to abandon it after a year's application. Upon reaching his majority he became an extensive contractor on public works, and he and his brother Alanson, who was connected with him, were called the "boy contractors." The firm's handiwork can be seen on the New York and Erie canal, the Ohio canal, and the tunnel through the branch of the Allegheny mountains on the Conemaugh River was also constructed by them.

In 1829, after his marriage, he removed to Pennsylvania and soon afterward to Michigan. He officiated as county judge till 1865. In 1837 he was elected by the Michigan Legislature as commissioner of internal improvements, and in that capacity surveyed the St. Joseph river for slack water navigation, and had the partial superintendence of the Michigan Central Railroad. He commanded a regiment in the Black Hawk war. In 1836 he did a large amount of contracting. In 1840 he removed to Chicago. He assisted in the construction of a railroad from East St. Louis to Vincennes, Ind., in 1852; in 1853 and 1854 the firm of which he was a member built a railroad from St. Louis northwest to the Iowa State line, and in 1855 they constructed that part of the Vandalia Railroad between St. Louis and the Wabash River. He served as postmaster under President Polk from 1845 to 1849. He leaves two daughters. He divided $600,000 among his relatives.

A SHORT HISTORY OF SOME RAILROAD MEN.

Apropos of the probable change of the Delaware and Hudson canal into a railroad, a story is told of several of the prominent officials of the Delaware and Hudson company. In the summer of 1836 a bare-footed boy was on his way to Honesdale, walking on the towpath of the Delaware and Hudson canal. When four miles this side of Port Jervis, and still forty miles from his destination, he was overtaken by a canal-boat. He was asked to jump on board and ride, which he did. On the boat was a Scotch family, just landed in America, who were on their way to the Pennsylvania coal-fields. One of its members was a lad 11 years old, the same age as the young pedestrian. A strong friendship grew up between the two boys by the time they reached Honesdale. The Scotch family went on to Carbondale, the center of the Lackawanna coal-field. The boy who had been given the ride on the boat obtained employment on the canal. The Scotch boy, his friend, worked in the mines for a short time as mule-driver. Both he and the former bare-foot boy rose in the company's service. The Scotch lad of forty-seven years ago is Thomas Dickson, president of the Delaware and Hudson Canal Company. His friend, the other youth, is Col. F. Young, general manager of the company, and president of the Albany and Susquehanna Railroad, which is controlled by the company. Mr. Dickson, Mr. Young, Mr. Oliphant, the treasurer of the company, Mr. Van Sicklen, superintendent of the coal department, R. Monville, superintendent of the Pennsylvania division of the company's railroad, and Mr. Weston, general real estate agent, were all born in 1824, the year in which the ground was broken to construct the canal.

THE CITY'S PUBLIC WORKS.

COMMISSIONER THOMPSON'S REPORT FOR THE FIRST QUARTER OF 1883.

Commissioner Thompson, of the Department of Public Works, says in his report for the first quarter of 1883 that the expenditures in that quarter were $782,070, and the revenue was $149,975. The expenditures included $155,403 for street improvements and $224,164 for the improvement of the water supply. The department let thirty-four contracts, whose estimated cost is $659,635, and completed eight contracts, which cost $324,099. Twenty-eight contracts for grading streets were in progress during the quarter, and a large amount of repairs was done on the macadam roadways and unpaved streets in the upper part of the city.

At the close of the quarter there were in the city 391 miles of sewers and 470 receiving basins, and 28,792 gas lamps and 128 electric lights. The Bureau of Encumbrances issued 642 notices for the removal of obstructions, and removed 1,303 cart-loads of stone and other refuse material from the streets. The department also laid 4,317 feet of water pipes and increased the number of water meters from 6,817 to 7,063.

The inspectors on waste water made 7,317 house inspections, and detected and stopped 988 leaks in water fixtures and 82 cases of willful waste. The night inspections of sewers and house drains showed 46 places where water was wasted between midnight and 6 A. M. at the rate of from one to twenty gallons a minute.

The severity of the winter prevented the doing of much work on the reservoir and conduit line from the Bronx River, and rendered necessary a large amount of repairs on the Croton aqueduct.

During the quarter the aqueduct was fully supplied from the natural flow of the Croton River, and there was a large surplus running over the Croton dam into the Hudson River at a depth of from one inch to thirty-two inches. The rainfall was 9.68 inches in the Croton valley and 9.66 inches in the Bronx River.

HEAVY CANNONS BY RAILROADS.

Pittsburgh manufacturers are moving to establish a national cannon foundry in that city. The guns hereafter to be manufactured for men-of-war and harbor defense will, on an average, weigh 100 tons, and there is a question as to whether existing cars, tracks and bridges will support such loads. Captain Reilly, commandant of the arsenal at Pittsburgh, is inclined to think the project entirely feasible, and he adduces European precedents in support of his position. In 1879 a gun weighing upward of 110 tons was carried by rail from Turin to Spezzia, in Italy, a distance of about 300 miles, the car on which it was carried having previously, on a trial trip, carried iron plate weighing 120 tons for a distance of 120 miles. Herr Krupp's enormous guns are conveyed to their destination by railroad, and Captain Reilly observes that "the whole question, therefore, comes down to the relative position of railroads in Europe and America, and the advance of railroad enterprise in one country over the other. If our railroads are as good to-day as theirs, then the same feats can be accomplished here as well as in Italy and other foreign countries, where railroads have always been supposed to be behind American enterprise."

OLD TIME RAILROAD MAKING.

A person who was a witness to the breaking of ground for the Baltimore & Ohio road discourses as follows: "The day was made a holiday in Baltimore, and a procession on wheels was one of the features of the day. The procession was a couple of miles in length, and every industry of the city was represented. Charles Carroll, of Carrollton, who was one of the signers of the Declaration of Independence, threw the first shovelful of dirt and delivered an address before thousands of people. The work moved slowly for several years, and not until 1831 was a locomotive put in service. The cars, prior to that date, were handled by horses. July 4, 1831, the road was opened to Ellicotts Mills, twelve miles distant from Baltimore. This was made an occasion of another grand celebration. Mr. Morrison was one of the passengers on the first train over the road. The trip to Ellicotts Mills was made safely, but on the return to Baltimore the engine exploded. The engineer and fireman were both scalded and died from the injuries then received, and several passengers were injured in jumping from the cars, which were double-deck cars, and were much the same proportion as stage coaches of that day. This being the only engine the Baltimore & Ohio people had, while it was in process of rebuilding horses were used to haul the cars between Baltimore and Ellicotts Mills, and one of the greatest feats of that day was the hauling by one horse, of fifty barrels of flour on a couple of cars, from Ellicotts Mills to Baltimore, in one hour and ten minutes. At that time Baltimoreans only talked of building to the Ohio River and of then using the river to reach New Orleans, the trade at that time being very large between the cities of Baltimore and New Orleans. Only the most sanguine expected to get the road to the Ohio River in less than fifty years. But the enterprise at once became popular, and citizens of Baltimore showed a willingness to aid the work financially or otherwise. But necessarily the work through the mountains on to Cumberland moved slow, yet the friends of the project lost none of their interest, and for many years only through the death of some one of the original stockholders was any of the B. & O. stock placed on the market, and to a great extent this remark is applicable to-day.

NEWS OF THE WEEK.

PRELIMINARY SURVEY.—Major Hunt, late of the Fargo & Southwestern Railroad, has started out from Brainerd northward with a corps of engineers and axemen to make the preliminary survey of the Brainerd, Grand Forks & St. Paul Railroad. This survey will be completed to Grand Forks in about six weeks, when the permanent survey will be made and grading commenced immediately. It is the design of the company to construct and equip the Brainerd & Grand Forks division first, to which bonuses have been pledged nearly reaching $500,000, from the counties along the line. Meanwhile the counties along the Brainerd & St. Paul division will be canvassed, and that portion of the road pushed forward in the same way next season. The company hope to have the road completed by Dec. 1 from Brainerd to Park Rapids in Hubbard County, a distance of sixty-five miles. C. F. Kindred is the chief financial mover in this enterprise

STATE OF TAHOMA.—It is now proposed to change the name of Washington Territory, upon her admission into the Union as a State, to Tahoma, which is said to be the proper orthography for the name usually written Tacoma. Tahoma is an Indian word meaning "almost to heaven," and was the name given by the Indians to Mount Ranier on account of the great height of that mountain, which is put down at fourteen thousand feet above sea level. We feel inclined to favor the proposed change of name for many reasons. Nearly every State and Territory has a county of Washington. Should Washington and Idaho be admitted as States, with North Idaho as an adjunct of the western sister, and with names unchanged, we would have the distressing anomalies of a Washington county in Idaho and an Idaho county in Washington, besides a town of Washington in Idaho County, State of Washington.

THE ST. ANTHONY BRIDGE.—Eight gangs of men are at work on the viaduct over the river at the foot of the falls. The contractors have been engaged for a year and a quarter, but they do not hope to have it finished before the end of the two years, if even then. Its present condition is about as follows: Of the twenty-four piers, twenty-three are completed. Pier No. 12, directly in the middle of the channel of the river, was abandoned early in the spring, it being found impossible to keep the water out of the crib, but work on it will be resumed when dry weather sets in. The expense attending the operations thus far done on this pier is said to exceed $20,000, and not a stone yet has been laid on it. On the eastern end nine arches have been completed, except the coping wall and parapet. The work of filling in is in progress here, the material being broken rock. On the western end, arches 20, 21, 22 and 23 have been finished, and the coping and parapet put in place. Arch No. 10 is up to the twelfth course. On 11 and 12 nothing has been done, owing to the inability of the contractors to put in the pier. The "center" is up for 13, and about eight courses of rock have been laid on its western side. On arches 15, 16, 17 and 18 the rock is laid up to the eleventh or twelfth course. Six caissons are being sunk and two are in place. Divers are busy with the remainder, and in less than a month they will be ready for the bridge, which is now on the ground.

PHILADELPHIA WATER-WORKS MACHINERY.—Proposals for the construction, erection and equipment of pumping engines at the Spring Garden, Frankford and Roxborough pumping stations were opened at the Water Department yesterday. For the two 15,000,000-gallon pumping engines and foundations at the Spring Garden Works the bids were: Knowles Steam Pump Works, $89,000, work to be completed before November 1, 1883; Holly Manufacturing Company, Lockport, New York, $67,000 each; Robert Wetherill & Co., Chester, $90,000, work to be completed ten months after receiving order; Henry R. Worthington, New York, $81,000, one engine to be delivered in seven and the other in nine months; Southwark Foundry and Machine Company, $88,950, to be completed in seven months from date of contract. Gordon & Maxwell Company, Ohio, $174,840, work to be done within eighteen months from date of contract.

W. Cramp & Sons offer to supply a 10,000,000-gallon pumping engine and foundations for the Frankford station for $49,500 and George R. Wilkinson for $42,500.

The Knowles Pump Works will erect a 7,500,000-gallon pumping engine and foundations at the Roxborough works for $43,000; the Holly Company will do the work by June, 1884, for $67,000; Wetherill & Co., in ten months from receipt of order, for $45,000; Henry R. Worthington, in seven months from date of contract, for $36,000, while the Gordon & Maxwell Company want nine months' time and $78,660 for the same work. The Chief Engineer and the committee on extension will decide between the bidders to-day (Saturday).

GRAND RIVER AVENUE, DETROIT, is to be repaved, and the objections made have been overruled.

THE OREGON SHORT-LINE RAILWAY is now being pushed westward from Shoshone, Idaho, and junction will be made with the Oregon Navigation Railway Company next Fall.

THE MEXICAN CENTRAL has now 45,000 men at work on its four divisions. A great deal of work will be done during the summer. Another dispatch dated May 25 states that heavy rains have washed away four bridges.

A NEW IRON BRIDGE is to be built at Enfield, Conn.

DYNAMITE PUT TO BAD USE.—Series of experiments lately conducted prove that two to four ounces of the proper quality of dynamite, exploded against the door of almost any bank safe or vault opposite where an ordinary time lock is placed, has in numerous cases opened the chronometer instantaneously, and some in common use have been opened in several ways at one explosion. That this compound can be used with safety to the burglar and with no damage to anything except locks and safe was proven by the late robbery of the bank at Vassar, where dynamite was the means employed.

THE PAVING OF ST. PAUL'S (Minn.) Seventh street does not seem satisfactory. The contract for paving the street from Jackson to the Seven Corners is let to J. J. Palmer for $29,990, and the work is to be finished by July 21. The contract calls for granite curbs, five inches wide, four feet long and eighteen inches deep, with tops bush-hammered. It is estimated that there will be 5,280 lineal feet of curbing, 6,100 cubic yards of cutting and grading, and 16,100 square yards of paving.

The contract requires that there shall be three inches of sand or gravel pounded down, on this shall be placed pine planks two inches thick, resting on stringers one inch thick by eight inches wide, placed under the plank at each end and in the center. On this bed are placed cedar blocks not more than eight inches in diameter and without bark or flaws. There shall be two fillings of the spaces between these blocks of gravel from the size of peas to that of walnuts, and these shall be rammed down. Over this shall be poured composition of hot tar of one and one-quarter gallons to the square yard.

There shall be another filling and ramming and three-fourths of a gallon of composition poured over this. The city engineer states that it had been customary for the city to place a coating of tar over the board flooring, but other cities had done away with it as useless, and so had St. Paul. He thought, however that a bath of tar would be good.

THE MOST MALARIOUS.—Italy is the most malarious country in the civilized world. Of the sixty-one provinces of the kingdom only six are nominally free from what is known as miasmatic or Roman fever, and in twenty-one the scourge assumes really serious proportions. Every year no fewer than 40,000 men in the army are attacked by the disease, and it is calculated that the prevalence of malaria necessitates the annual expenditure by the government of something like ten million lire for the maintenance of special hospitals for public servants. It has been found that the extension of the railway system throughout the peninsula has increased the evil. The turning up of fresh damp earth, and the unavoidable formation of new banks, deep cuttings, and excavations which speedily fill with water, breed the disease in its worst forms. On one of the railway lines which runs through much marsh land the annual rate of mortality among the employes is 36 per 1,000.

NEW BULKHEAD.—At the meeting of the N. Y. Dock Commissioners on Monday, Chief Engineer Greene was instructed to prepare plans and specifications for the construction of a bulkhead 200 feet in length, north of the foot of Seventy-ninth street, North River.

THE INDIANA STATE-HOUSE.—This is the way a reporter on an Indianapolis paper tries to find out information as to progress on the buildings:

"What are the commissioners doing in regard to the work on the State-house?" was asked yesterday afternoon.

"They are proceeding according to the law," replied General Morris.

"Have they any decided intentions as to what they will do?"

"They are acting under the direction of the Attorney-General, and are waiting on the contractors."

"What are they waiting on the contractors for?"

"To see what they will do."

"What are they doing?"

"They are working."

"Have they complied with the monthly details of work given them?"

"Not fully."

"Then will their contract be declared abandoned?"

"That will depend upon matters. It is no small thing to declare a contract abandoned."

"Well, if the commissioners do anything in regard to the reletting of the contract for completing the building, how soon are they likely to do it?"

"Not before August or September." [The reward of perseverance.—Rep.]

Having found the needle in the haystack, the reporter withdrew. The work on the State-house at present is progressing slowly and irregularly, the force of men employed varying from twelve to thirty. It is altogether likely that the contractors will be permitted to proceed this summer without interruption, and there will be some profit in the work which they will do,

THE annual meeting of American Railway Superintendents was held May 29, at Chicago. Among the officers present were Waterman Stone, Providence, R. I.; E. T. D. Myers, Richmond, Va., and O. M. Shepard, of the New York, New Haven & Hartford road. The subject of standard time was discussed, and the association, by a resolution, heartily expressed its approval of the railroad

time standards proposed by W. F. Allen, Secretary of the General Time Convention, held in St. Louis, April 11, and declared that wherever practicable it would adopt his system. The next meeting of the Association will be held at Washington, Oct. 23.

THE OREGON & CALIFORNIA'S TUNNELS will be five in number; that through the Siskiyou mountains will be 3,070 feet in length. The longest of the other tunnels will be 1,760, and the shortest 250 feet. The road will build their extension two miles south of the California boundary. The point of junction will be settled at a conference between Chief Engineer Morris, of the Oregon & California, and Chief Engineer Montague of the Central Pacific road.

THE CANADIAN PACIFIC—VICTORIA, B.C., May 22.—It is reported that instructions have been received at Port Moody to stop all work on the railway between the latter point and Pitt River. It is believed the object is to divert the line of the railway from Port Moody to Coal Harbor and English Bay, which affords easier ferry connection with the Island Railway and Victoria.

WILMINGTON, ILL. BRIDGE. CORRECTION.—Your paper of May 26, notes the contract for our iron highway bridge over the Kentucky River at Washington Ill., has been awarded to the Pittsburgh Bridge Co. TENOR.

The contract has been closed with Wrought Iron Bridge Co., Canton, Ohio. Three spans 166 ft. each. Price $17,727.

NORFOLK & WESTERN R. R.—The monthly statement of net earnings for April, 1883, shows an increase over the corresponding month last year of $14,414 or 21.5 per cent.

SHERIFF'S SALE OF PATENTS.—A sheriff's sale of a machine covered by a patent carries with it a right to use the machine sold to the full extent that it could have been used by the execution debtor. This was the view taken in the case of Wilder vs. Kent, decided by the United States Circuit Court for the Western District of Pennsylvania, on February 2. The plaintiff alleged that he had received from certain persons who had obtained a patent for a grinding machine a grant of the exclusive territorial right to the patent for certain counties in Pennsylvania. He had placed two such machines in a woodenware factory. A judgment was obtained against him, and the factory and the machines were sold under execution. Suit was brought to enjoin the use of the machines by the defendants who had purchased the premises and were operating the factory. Judge Acheson, in dismissing complainant's bill, said that the lawful sale of a patented machine takes it out of the monopoly either absolutely or pro tanto according to the nature of the contract. The purchaser of a machine from the patentee acquires no rights in the patent itself and needs none to enable him to enjoy his acquisition. By implication he is invested with a license to use that particular machine, and in the absence of express provision to the contrary such license passes with the machine to successive owner as an incident of proprietorship. That such is the law in the case of a voluntary sale is incontrovertible. The rule is that the purchaser at a sheriff's sale succeeds to the beneficial rights of the defendant to the property sold. To deny the vendee the right to use such machine would in effect prevent its sale upon an execution as an operative apparatus, and practically withdraw it from the reach of an owner's execution creditors. The conclusion arrived at by the court was that whatever rights to use a patented machine a defendant may have passes with the machine when sold by the sheriff to his vendee.—*Bradstreet's.*

THE CANADIAN PACIFIC COMPANY has not, it is asserted, fulfilled its promise of beginning work on the branch connecting Ontario with Prince Arthur's Landing. The syndicate find they have an entrance to the Northwest over the American systems. The matter of building the road is now before the Dominion Parliament. It is proposed to subsidize the Canadian Pacific branch to the extent of $12,000 a mile, the Dominion Government giving $6,000 and the Ontario Government the other half. It is thought, however, that the track will not cost on an average over $8,000 or $10,000 a mile, and it is proposed to give only that amount or less.

THE REDUCTION of the grade of the Canada & Atlantic was tested lately by a train from Ottawa, with an equivalent to 45 cars carrying ten tons of freight each. The object of reducing the grade has been with a view to lessen the rate of freight carried over the road, as the railway was originally projected to make a new and cheap outlet for the immense lumber products of the Ottawa Valley to the New England States. The road is in operation from Ottawa to Coteau on the St. Lawrence, a distance of 77 miles. About 50 miles east of the St. Lawrence will complete the link to connect with the Central Vermont at Alburgh, Vt. Of this portion the rails are now being laid upon about 20 miles, and work is progressing on the remaining 30 miles.

THE SOUTHWESTERN TELEGRAPH AND TELEPHONE COMPANY was incorporated in New York May 25. The lines are to run from Saratoga and Albany, southwesterly to Galveston and Austin (Texas), the capital is $2,000,000.

THE CHICAGO, ST. PAUL AND NORTHERN RAILWAY COMPANY has been incorporated at Madison (Wis.) The line is to commence near Genoa, Walworth County (Wis.), running northwesterly to Lake Superior near Superior City, with a branch in Juneau County, beginning at Necedah and running to St. Croix River in Pierce County. Also with a branch commencing near Geneva and running to Milwaukee. The main line is to be 352 miles in length, the branch to Clifton Mills 145 miles, and the branch to Milwaukee 44 miles. The capital stock is 11,000,000. The number of directors is seventeen, and among them is found the name of Gen. W. S. Rosecrans, of San Francisco.

A SHORT LINE TO QUEBEC from Toronto and Chicago is spoken of. The Canadian Pacific will build a connection between St. Louis, near Montreal, and the Lake St. John Railway, near Quebec, at the Batiscan River. This will shorten the distance to Quebec by 100 miles.

THE SUEZ CANAL is in a fair way of becoming an open and stagnant sewer. The stations on its banks are drained into its waters. It is never flushed, there is no tide and the stench is becoming intolerable. Diarrhœa and sickness prevail in vessels detained in the canal, and as detentions are increasing in number and duration the matter is becoming serious.

THE WATER-GAS CO. has been denied to enter Detroit. The company is known as the United Gas Improvement Co. Some of the aldermen seemed in favor of having the city make its own gas. The great objection, however, was that the new company might sell out to the Mutual.

AN EXTENSION of the Wisconsin Central, from Chippewa Falls, Wis., to St. Paul, Minn., is contemplated this season. The object is to touch the great lumber business of the Northwest.

PLYMOUTH, MICH., is to have a telegraph and telephone line to Detroit.

THE CHICAGO AND WEST LYNNE line has been begun. The Chicago, Burlington & Quincy has declared its intention of building an independent line from Clinton, Iowa, to Sioux City, and thence to boundary line.

THE NORTHERN PACIFIC is now completed to Townsend, a distance of 1,120 miles from St. Paul, Minn. Upon the completion of the road to Helena, going west, and to Missoula, coming east, on June 10, but 130 miles will remain to be finished, and this will be done about September.

MANCHESTER (VA.) WATER SUPPLY.—The following message will be submitted at the next meeting of the Manchester Council. It is given in advance, as it concerns both cities:

MANCHESTER, May 23, 1883.

Honorable President and Members of the City Council of Manchester:

GENTLEMEN—I recommend that by resolution the proper committee of your honorable body be authorized to confer with like committee of Richmond Council to ascertain upon what terms our city may be supplied with water from the public works of their city. As to the feasibility of the plan, I have consulted authority on the subject before making this suggestion. I think the project would be advantageous to both places. Very respectfully, JOHN E. TAYLOR, Mayor.

SALE OF THE WASHINGTON & WESTERN RAILROAD.—The Circuit Court of Richmond has confirmed the sale of this road to Geo. H. Bates and others. The price is $400,000, of which $153,000 has been paid in cash. This road has changed its name several times. It now runs from Alexandria to Round Hill (Va.), 51 miles, but will probably be extended to Winchester.

RICHMOND (VA.) GAS WORKS.—The contract for improvements has been awarded for the iron work to the Tanner & Delaney Engine Co.

THE ENGINEERS OF THE VIRGINIA AND NORTH CAROLINA R. R., who are surveying a route from Mecklenburg via Richmond, have crossed the Meherrin river. The chief engineer has been in Richmond, surveying routes.

THE BEECH CREEK, CLEARFIELD AND SOUTH WESTERN RAILROAD (Pa.) will be begun at once.

ELECTRIC LIGHTING is to be introduced in Danville (Pa.), and the business men of Pottstown have also organized an electric company.

NEW MICHIGAN RAILROADS.—The announcement is made that the Detroit, Marquette & Mackinaw Railroad is to be immediately extended from Marquette to the iron mines, and that a branch line is to be built from the main line to Sault Ste. Marie. At present the Marquette & Mackinaw finds an outlet to the iron mines by means of the Marquette, Houghton & Ontonagon Railroad, but the managers of this road have become so exacting in their dealings with the Marquette & Mackinaw that the latter has at last decided to build its own line to the mines. The new road is to be built by the Seney syndicate, which has raised a fund of $2,000,000 for the improvements and extensions contemplated. The distance of the road to be built from Marquette to the mines is fourteen miles, which, with various little spurs to the several mines, makes a total of seventeen miles. The country through which it is to be built is very uneven and rocky, and the cost of the work will be upward of $40,000 per mile. The length of the branch road from the main line to Sault Ste. Marie will be 48 miles, and will run through a heavily-timbered country. In connection with the branch road the syndicate will build a bridge across the ship canal and St. Mary's River, and by the terms of the charter the bridge must be completed before 1886.

THE TEXAS TRUNK RAILWAY having been purchased by eastern capitalists, will be extended very shortly from Kaufman, its present terminus, thirty-five miles from Dallas, in a southeasterly direction, to Athens, on the line of the Texas and St. Louis narrow-gauge, giving Dallas and Northern Texas outlet to St. Louis other than by the Gould and Huntington routes. Thence it is contemplated to extend the road to Nacogdoches to connect with the Houston, East and West Texas Railway, narrow-gauge, and from this latter point to Bethany, the present terminus of the Sabine Pass and East Texas roads, a distance of about sixty miles, with an easy country to build over.

NEW YORK, WEST SHORE & BUFFALO.—Officers of the New York, West Shore & Buffalo Railway state that there will be no postponement of the contemplated opening of that road for traffic betweeen New York and Newburg on June 4. The principal intermediate points on this part of the line are Jersey City, Haverstraw, West Point, Cornwall and Newburg. At Cornwall connection is made for all points on the New York, Ontario & Western Railway. The West Shore road will be opened to Kingston, Catskill Mountains and Albany on or about July 1. For the present trains on this new road will arrive and depart from the Pennsylvania station in Jersey City.

MORE COUNTY SEAT RIVALRY.—Rochester, New Hampshire, offers to raise $100,000 for county buildings if the seat is removed to there. The Dover aldermen will raise $50,000 for the same purpose.

FALL OF A BRIDGE AT AUSTIN, TEXAS.—The bridge over the Colorado River fell lately with sixty cattle. A proposition had been made by the bridge company some time ago to sell the property to the county, and County Judge Fulmore had employed a practical bridge-builder to inspect the same, who reported it defective, and would likely fall of its own weight in a short time.

CONTEMPLATED NEW RAILROAD.—A public meeting was held at Washington (Ind.) last week to advocate a narrow-gauge road from that city to Louisville. The distance is about 100 miles. It is stated now that the Toledo, Indianapolis & St. Louis road is really to be built, and that an engineering corps has reached Pleasant Mills. After leaving Van Wert (O.) the line will run southwest to Indianapolis. There are funds, it is stated, available for building 100 miles.

THE ST. PAUL (MINN.) BOARD OF PUBLIC WORKS at last meeting directed advertisements to be inserted for various city improvements.

UTAH & NORTHERN RAILWAY PROGRESS.—Work will soon be begun on the National Park branch in Montana. The point of divergence from main line will be near Glenn Station and up the Ruby to Virginia City, where it will cross and run up the Madison to the Fire Hole basin.

CONTRACT AWARDED.—Spencer's (Worcester Co., Mass.) sewer contract has been awarded to Marsh & Pease for $11,435, and $3.65 a yard for all rock work. The contract is for 2,700 ft. of 18 in., 600 ft. of 15 in., 3,500 ft. of 12 in., and 3,200 ft. of 9 in. Akron pipe. The highest bid was $24,000.

THE UNION ELECTRIC LIGHT CO. has been incorporated at Minneapolis, with a capital of $200,000. The St. Cloud Gas and Electric Light Co. has been also incorporated at Minneapolis. The capital is only $20,000.

A CONTRACT BETWEEN THE MANITOBA AND NORTHWESTERN RAILWAY CO. and the St. Paul Construction Company has been signed at Winnipeg. A. B. Stickney has gone to St. Paul to obtain the necessary outfit.

THE METHOD OF PAYING LABORERS on the Canadian Pacific has been changed by the contractors, Langdon, Shepherd & Co. Hitherto $200,000 was sent at one time in a car; in future the men will

be paid by check, payable to bearer. An attack on the money was feared.

THE COST OF ELECTRIC LIGHTING, at Springfield, Mass., is considered excessive. The bills of the electric light company in the hands of the city treasurer show that the average cost of each electric light in use on the streets is 68½ cents per night, and on this basis the four new lights ordered for Maple street would cost a round $1,000 a year. They are expected to displace 15 gas lamps, 9 of which are on Maple street and burn till 3 a. m., as long as the electric lights do, and 6 on adjacent streets, the latter being put out at midnight. The cost of one gas lamp for a year, including the expense for care and lighting, is $25.44, when burned till 3 o'clock, and the total cost of the 15 would be $381. Deducting the saving from not burning the six lights from 12 to 3 this total is reduced to $365, or $635 less than the sum required for the electric lights.

THE PAVING OF MECHANIC STREET, GALVESTON (TEXAS) will cost when completed some $70,000. The contractors are H. Taylor & Son, Kansas City, Mo.

GAS IN DAKOTA.—Sioux Falls is about to introduce gas.

THE BILL FOR EXAMINING THE MINNEAPOLIS water-works sent in by F. S. Blodgett of Milwaukee amounted to $600.

THE OPPOSITION GAS COMPANY AT MINNEAPOLIS is no longer talked about, and the six months allowed for a beginning of the works have expired.

SUEING A CONTRACTOR.—R. A. Roberge, of Montreal (Can.), sub-contractor under L. A. Senescal, is sueing the latter for $150,000 for work done on the North Shore Railroad.

THE SUNSET RAILROAD.—Col. T. W. Pierce, president of the line, has ordered work on the Mexican extension pushed, and forces are to be increased. N. F. Bell and others have left to push on the bridge work.

THE BRAINERD (TEX.) WATER-WORKS, Holly system have been begun, and will be finished by Sept. 1. The King Bridge Company of Cincinnati are to put on a new wagon bridge for $19,000.

PROPOSED COLUMBUS (IND.) EXTENSION LINE.—It is believed that the Bedford & Bloomfield and the Cin. Ind., St. Louis & Chicago railroad companies will connect the two lines, using the Columbus, Hope & Greensburg as the connecting link. The line would be 48 miles in length.

THE IRON TRADE continues depressed, and several mills in the West intend closing.

THE ENGINEER CORPS OF THE EASTON & BANGOR PA. LINE have finished their surveys and are now leveling. Large contracts for railroad ties have been made. Grading will be begun at once.

THE STREETS OF BROOKLYN are in a bad condition. The last Legislature allowed $300,000 for keeping them in repair, but the bill has not been yet signed.

THE DEEPENING OF GALVESTON HARBOR was thus alluded to by Col. Pierce of the Sunset route, on his recent visit to the city. "With 25 ft. of water on the Galveston bar the key to the situation is fixed. The future of the city depends on the solution of the deep water problem, and the whole people of Texas are interested in it, and it is a pity that they cannot undertake and assist in the work. An expenditure of $10,000,000 would be nothing for Texas in order to have deep water at Galveston, which within five years will be the first cotton port of the country."

NEW ROADS.—The Iowa, Nebraska & Kansas Railroad Company has been organized at Nebraska City with a capital of $1,000,000. The road runs from Nebraska City in a southwesterly direction through Otoe, Johnson, Saline and Sage counties to the Kansas line and thence southwest. Surveys will be made at once.

THE Springfield, Chicago & Southern will issue $2,000,000 in bonds to aid in building of road, which it is believed will be soon completed.

RIGHT OF WAY FOR THE SPRINGFIELD (ILL.) & SOUTHERN narrow gauge has been secured south from Springfield to the Toledo, Cincinnati & St. Louis narrow gauge.

THE FIGHT FOR RIGHT OF WAY between the Lackawanna, and Rochester & Pittsburgh railways still continue on the Humphreys farm (N. Y).

A NEW IRON BRIDGE will be built over the Alleghany river at Hickory, Forest Co., Pa., during the summer.

NEW TELEGRAPH COMPANY.—The Northern and Southern Telegraph Company, with $100,000 capital and the usual proviso for increase, has been incorporated. This company propose to construct lines from New York by way of Philadelphia to Charleston, S. C.

REBUILDING WARREN BRIDGE (BOSTON) was the subject of discussion at the last meeting of the Town Council. A letter from City Engineer Wightman was read, in which he says he must decline the responsibility of building the bridge, if it was to be done by day labor. Broadway bridge, the most expensive in Boston, was built under the direction of a committee, was the remark of one of the Aldermen. The Council finally adopted a motion that the work shall be done by contract.

THE WATERPHONE IN PHILADELPHIA.—The clever little detective which the Water Department of Philadelphia is examining with the purpose of adopting was given a trial on Wednesday in the presence of several experts of the Water office. The waterphone is the invention of the Superintendent of the Cincinnati Water-Works and is now in use in his own city and in Rochester, Buffalo, New York and elsewhere. Its appearance is similar to the receiver of the Bell telephone. A gutta-percha casing around an iron tympanum, with a steel rod half the size of a lead pencil leading from the tympanum to the lower end of the instrument, where it is held by a nut, the little rod extending beyond the nut about an inch, with a thread cut in it for the purpose of screwing it into a longer rod. The application of the instrument is readily made. The street box of a water-pipe is opened. A long iron rod, or "key," is extended into the box to reach the stop-cock of the side pipe leading from the street main into a private house. When this is affixed the waterphone is screwed into the top of the long "key." It is only necessary then to place an ear to the top of the phone to detect the slightest leak in the pipes. The sound of water running in the pipe is distinctly transmitted to the ear. In order to discover whether the waste is in the house or from that part of the pipe nearest the main, the cock is turned, stopping the flow of water to the house. If the sound continues, it comes from that part of the pipe between the stop-cock and the main.

ITALIAN BRIDGE.—Signor Giambastiani, an Italian engineer, has prepared designs for a bridge over the Straits of Messina. It is to be of steel, and three miles in length.

BRIDGE OPENING DAY.—The elevated railways have made a fortune by the bridge opening, the following being the number of passenger for Thursday: Second Avenue, 34,082; Third Avenue, 198,205; Sixth Avenue, 119,593; Ninth Avenue, 37,210.

NEW IRON BRIDGE.—The Susquehanna and Southwestern Railroad Company has determined to build an iron bridge over the Moshannon that will be 700 ft. long and 105 ft. in height. As soon as the railroad is completed the company will build a large summer hotel on Gorton Heights, near the Big Moshannon.

THE VANDALIA EXTENSION has now reached 13 miles above Logansport. The surveying parties are working on the routes north of the Nickel Plate. Michigan City will be doubtless the northern terminus.

THE ATLANTIC & PACIFIC CO'S BRIDGE over Canon Diablo is 240 ft above water and 541 ft long.

A QUEER NAME for even a locomotive, is that of "Neebanawbaigs," which is painted on a new engine on a Western road.

THE LAKE MEGANTIC ROAD is being rapidly advanced, and the force employed on it will soon be increased to 600 men. This is the proposed air line from Montreal to St. John, N. B., and will be 460 miles in length. Of the distance to Montreal 298 miles are built, 37 are under way and 135 remain to be constructed.

THE SHORE LINE ROAD will be in running order from Bangor to Ellsworth (Me.) by November. The contract to grade the last 18 miles was let last week to Danforth & Ward.

A BIG SURVEY IN MEXICAN LANDS will be that for a syndicate of Texan capitalists who obtained leave to survey 15 million acres of land in the States of Zacatecas, San Luis Potosi and Durango. The Dallas parties were to receive $100,000 for the survey and one-third the land.

CALIFORNIA WANTS ANOTHER ROAD.—A gentleman says: "Mr. Villard could build one. The Union Pacific might extend one of its Utah lines. The Denver & Rio Grande could climb the mountains, while the Atlantic & Pacific is in a position to invade the forbidden territory whenever it shall be deemed wise to do so."

CORPUS CHRISTI HARBOR (TEXAS).—Jetties for the improvement of the ship channel are in progress of construction, and it is expected a depth of twenty-five feet of water will be attained.

KNOXVILLE'S WATER SUPPLY—KNOXVILLE, Tenn., May 30.—The Knoxville Water Company turned the water into the mains to-day with imposing ceremonies. The water-works, with a capacity of 4,000,000 gallons per day, have just been completed at a cost of $150,000. There are 12 miles of water mains. An accident occurred to-night, causing considerable damage to the water-works. The bottom of one of the two reservoirs dropped out, emptying in five minutes 500,000 gallons of water into a cave beneath. The existence of the cave was not previously known. The other reservoir was not damaged.

THE CAPE COD CANAL Senate Bill was discussed in Massachusetts House, on May 29. Mr. Sherburne presented the statistics in favor of the canal and the claims of the proposed corporation. He claimed that in all the investigations into the subject for more than a hundred years none had opposed the feasibility of this work. The statistics of vessels passing around the Cape indicated that there were about four million tons of freight. Mr. McGeough intimated that the incorporators were not of sufficient financial standing for the carrying out of the work. No vote was come to, and the papers were laid on the table.

LYNN (MASS.) WATER SUPPLY AND DRAINAGE.—A petition from the city of Lynn, to take the waters of the Saugus River and issue bonds for $250,000, has been presented to the Massachusetts Legislature.

THE ARIZONA MINERAL BELT ROAD is being surveyed from Winslow on the Atlantic & Pacific to Globe City, Arizona, with the view of ultimate extensions to the junction with the Southern Pacific at Benson.

THE IRON AND METAL MARKET.

PHILADELPHIA, MAY 31.

The eastern Pennsylvania iron market is in a bad way for crude, while finished iron is in improving request, and prices are hardening. Prices have fallen to $17@$18 at furnace for forge. Foundry irons are very dull; large offerings are being made at prices as low as $19 for No. 2, while $21 has been readily accepted for No. 1. These are the lowest prices known of for years. But little stocks have been moving, and consumers are indisposed to cover summer requirements at any price. The downward tendency is likely to still further depress prices, and buyers are purchasing weekly requirements until they can see the way out of the swamp. The Allentown Iron & Coal Company gave the trade quite a shock, but other companies could take the same course with as much wisdom. At the present cost of iron, there is nothing in it. Stocks are large, and nothing but a very general restriction will restore confidence and bring prices back to a remunerative limit.

Muck bars are stronger in consequence of the improving demand for refined, and upward of 1,000 tons have been contracted for at $34.50@$35. Small sales of charcoal blooms have been closed at $62. Merchant iron is firm at 2.20c. at mill, and orders are increasing, both here and in country mills. The inauguration of the strike in the West has made buyers anxious for at least a few weeks' iron. The same activity prevails in nails. Structural iron is also more active and firmer.

Steel rails are moving freely in occasional heavy lots at $38@$39. Old material is dull, and scrap is without sale except in retail lots at $23.50@$25.50.

Gray forge iron has sold at $16@$17.50 in small lots. A good many furnaces are going out of blast. Foundry irons are very weak. Merchant bar is selling at 2@2.10c., and it is probable that customers' needs can be taken care of. Nails are active and firm. Construction iron has been moving freely in small lots all the week. Steel rails are not affected by the strike, and the steel mills will continue to run. Merchant steel is in abundant supply, but there is no unusual cutting. The demand for steel for agricultural purposes has been heavy, but this is the dull season, and trade is slack.

CHICAGO.

A better feeling prevails in bar iron and nails. Prices have advanced slightly. Manufacturers have not taken orders for future deliveries, and are preparing for the suspension. Buyers are quietly awaiting the outcome. Galvanized iron is in good demand. Black sheets are scarce and firm. Nails are scarce and active at $3.25. Small orders for rails are booked at $41. There is decreasing activity in all kinds of merchant steel. Pig iron is a drug, and prices are very weak.

CINCINNATI.

Dullness prevails in almost all branches of the iron trade. Manufacturers here will stand by the East. There is no material change in production, though prices show a declining tendency in pig iron, while foundry irons are firm. Stocks are light in consumer's hands, but there is no special anxiety as to the filling of future requirements.

JUNE 1.—There will not be any strike. Manufacturers have signed the scale, and labor is settled for one year.